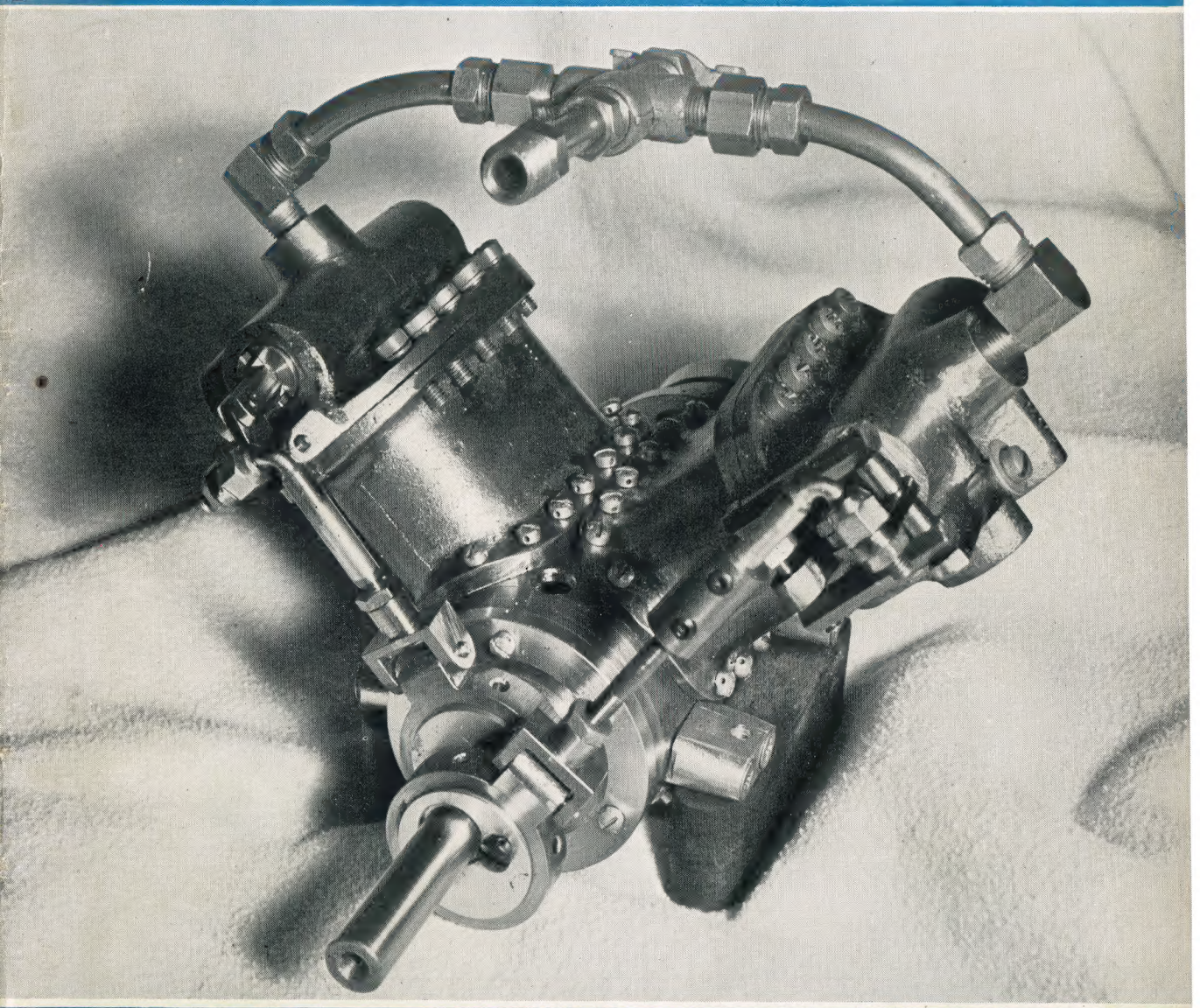
THE MODEL ENGINEER



IN THIS ISSUE

● IN THE WORKSHOP—MAKING AN ELECTRIC HAND DRILL MULTI-FEED GEARBOX FOR THE M.L.7 ● READERS' LETTERS ● L.B.S.C.'s TITFIELD THUNDERBOLT — BOILER FITTINGS ELECTROFORMING COMPONENTS ● QUERIES AND REPLIES

JULY 22nd 1954

Vol. 111 No. 2774

9D

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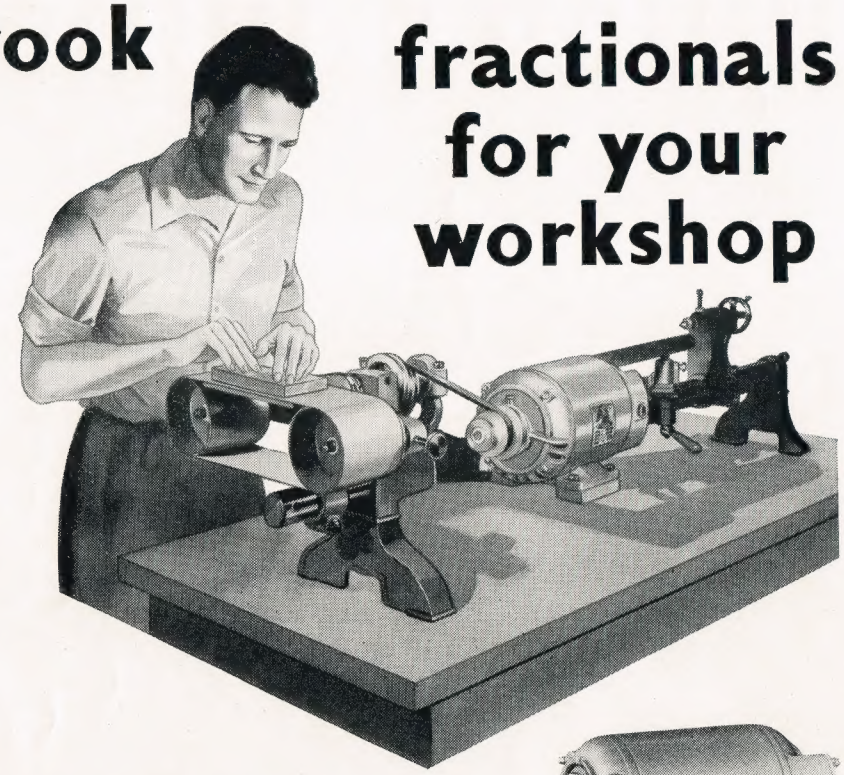

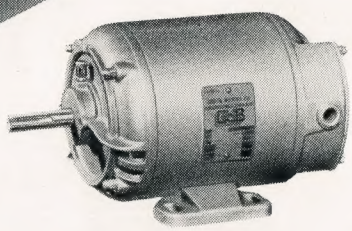

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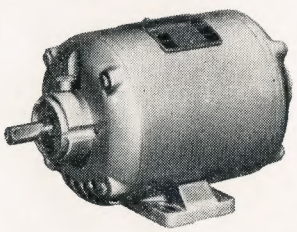

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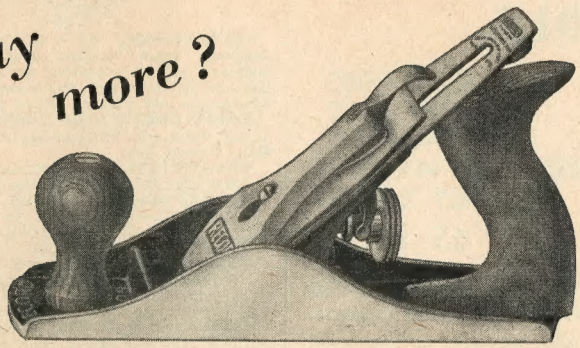

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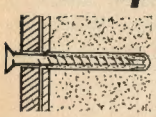

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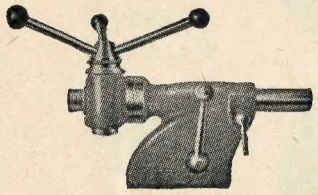

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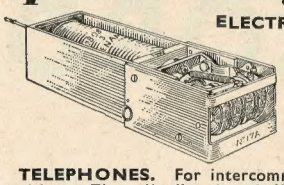

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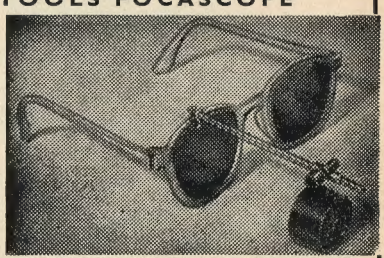

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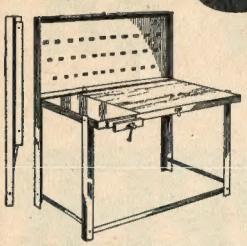

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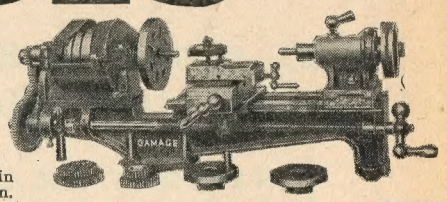

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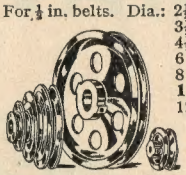

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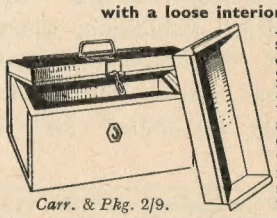

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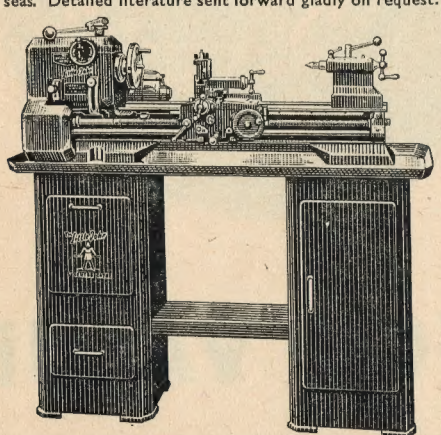

Brief Specification : Height of centres, 5⅛" ; swing over saddle, 6½" dia. ; admits between centres, 24" ; spindle bored, 1-1/32" (No. 4 M.T.) spindle speeds, ungeared, 1750-290 r.p.m., geared, 260-38 r.p.m. ; width of bed, 6⅛" ; leadscrew, ¾" dia. x 8 tpi. ; overall lenght of bed, 43" ; approx. weight (less stand) 3½ cwt.

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Volume 111 - No. 2774

JULY 22nd - 1954

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W.1.

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Our Cover Picture

An American reader, Mr. Ralph J. Rasmussen, of New Baltimore, Michigan, has sent us this picture of a very interesting "vee-four" steam engine which he has constructed. It has single-acting cylinders, 1 in. bore by 1 in. stroke, having aluminium pistons, each with a single cast-iron ring. The connecting-rods are of aluminium alloy, with split bronze big-end inserts, and the main bearings are also of bronze. This particular type of engine has good inherent balance, and although it has a theoretical rocking couple on the shaft, and also unbalanced valve movement, it is stated to be entirely free from vibration at 3,000 r.p.m.

The design follows closely that of the engine described in "The Model Engineer" during 1952, by Dr. W. W. Lacey, of New York. It is intended to run it on flash steam, and the plant will be fitted to a vee-bottomed boat of 42 in. length, driving a 3⅛ to 4 in. diameter two-bladed propeller; in which capacity it should be capable of very high performance.

SMOKE RINGS

The "M.E." Exhibition Entries

AT THE beginning of July last year, the number of completed entry-forms received from entrants for the Competition was 53. This year, the number was well over 80 at the same date, and they seem to show that some very interesting work is to be sent in. For example, among the locomotives is a 2-in. scale replica of the ex-L.N.W.R. 2-2-2 type engine, *Lady of the Lake*, the work of Mr. H. C. Powell, of Crewe. It is 7 ft. 6 in. long and weighs 4½ cwt.; readers who can recall seeing the splendid 1½-in. scale L.M.S.R. "Duchess" class Pacific locomotive which Mr. Powell exhibited in 1948 will be intrigued by the contrast provided by his latest engine, but will naturally anticipate first-class work.

Incidentally, we would remind any readers who have any small brazing jobs to be done, to bring them along to see how Brigadier J. C. Richards or Mr. Chas. Kennion can do them on the Demonstration stand. The only cost will be that of the brazing materials.

A Special Prize for Model Power Boats

WE ARE pleased to announce a new addition to the list of special prizes at the "M.E." Exhibition, namely, an award of three guineas for the best example of a model power boat designed specifically for regular working under regatta conditions. This has been donated jointly by Messrs. E. Bowness, A. D. Trollope and E. T. Westbury, and its object is to give greater encouragement to the type of boat which is very popular in club competitions, but for obvious reason cannot be built with such fine details or high finish as models intended mainly for exhibition. An essential condition in boats eligible for this prize is that they should have successfully passed working trials on the water, to prove both the seaworthiness of the hull and the practical soundness of the power plant, though this does not necessarily entail efficiency tests in either respect. Some evidence, such as a letter from a club secretary or other competent authority, to show that the boat has actually been run, should be submitted to the judges by entrants.

Photographic Competition

PRIZES OF £50, £25 and £15, plus seven consolation awards are to be given by the journal *Amateur Photographer* (Associate Iliffe Press) for the best photograph of an engineering model of any kind. The first three prizes will be in voucher form to enable the winners to choose their own photographic equipment.

The competition is being organised to coincide with the MODEL ENGINEER Exhibition, at the New Horticultural Hall from August 18-28, 1954. The photographs submitted—measuring not more than 10 in. × 8 in. and unmounted—must have been taken by the competitor, but may be developed commercially. Every entry must be accompanied by a "Competition Coupon" cut from *Amateur Photographer*. Closing date is September 30th. A full set of rules will appear in "A.P." on August 11th.

One of the attractions of the *Amateur Photographer* stand at the Exhibition will be a colour film, lasting about 10 minutes, showing beginners how to set about making contact prints from their negatives.

"Championship" Model Cars

THE MODEL Car Championship of Europe races will be run in England this year, at the Chiltern Track, near Luton, on August 15th. British model racing car enthusiasts naturally hope that the British team will win; but even if it does not, it is sure to put up a good show. We are hoping that the British team models will be exhibited on the Model Car Club's stand at the MODEL ENGINEER Exhibition, where they are certain to attract attention, whether or not they are victors.

A Small Tandem Paddle Engine

By H. E. Rendall

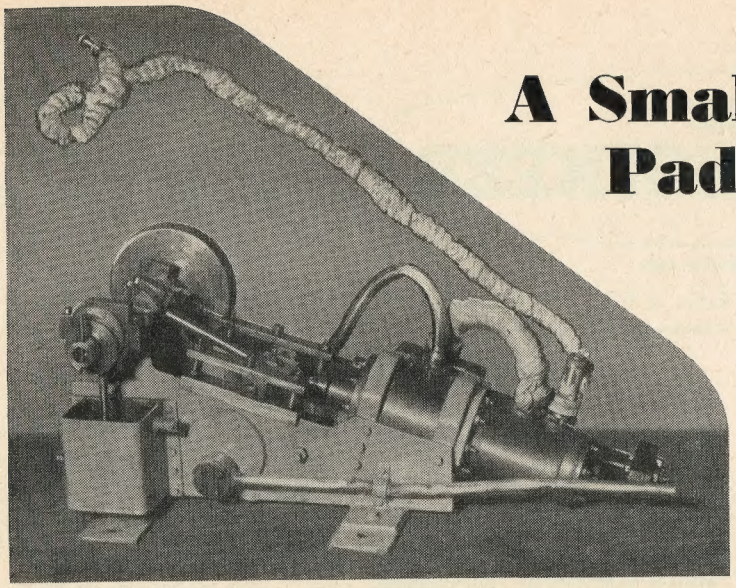


Fig. 1. *The small tandem paddle engine*

IT is very gratifying to be able to send a photograph of a small engine to THE MODEL ENGINEER and to report its complete success, but sometimes more lessons can be learnt from an engine that is not quite so perfect. Well, the small diagonal tandem paddle engine, illustrated in the photograph, runs satisfactorily, though as it did not fulfil the purpose for which it was designed, we must account it a partial failure; but, still, I feel that it is not devoid of interest.

When I was young I often used to go for trips in a paddle boat with a single-crank side-lever engine. For hours I watched that engine, while being manoeuvred, waiting expectantly to see it get stalled on a dead centre, but it never, never did. The internal friction of the engine was very slight—far less in proportion than in a model—and if the crank was the slightest degree over the dead centre, off it went. The slide-valve was worked by hand until the engine was well under way, so that the engineer could give it steam for the full stroke at starting. When I wanted to fit a new engine for a 4 ft. 6 in. paddler, I was fascinated by the idea of a single-crank engine and, frankly, I did not want to face up to all the work entailed in making a two-crank compound. I felt that steam would have to be carried for the full stroke, and expansive working would have to be obtained by fitting an l.p. cylinder in tandem, and I suppose that precisely the same considerations produced the design for the single crank diagonal compound, found in some of the Clyde paddlers. These engines could drive the boat at 18 knots or more, and had a long life, but the uneven crank effort gave the boats a literally sickening motion. I think it is worth while looking at some full-size tandem engine designs before describing my engine further.

Fig. 2 shows a tandem cylinder unit for a large marine engine. It will be noticed that there is a distance-piece between the two cylinders, and this was the usual arrangement. The l.p. cylinder is fitted with a double-ported slide-valve to give plenty of area for the low pressure steam, which is just about dead after finishing its work in the l.p. cylinder; but people may cavil at the size and volume of the h.p. cylinder passages, so let us face this matter fairly and squarely.

The clearance volume adds a slice to the front of the indicator diagram, and the net effect is that of giving a later cut-off than that given by the slide-valve, and furthermore it obviates high compression at the end of the stroke, which might give uneven running. Does not the h.p. cylinder in a Smith compound locomotive have a clearance space between the piston and the covers for the very same reason? If the valve was designed to cut off at $\frac{1}{8}$ stroke, the clearance might easily reduce the expansion ratio to 1 : $4\frac{1}{2}$. Large clearances certainly seem to be objectionable, but not so fatal to efficiency as they would be in a simple engine.

In some marine designs a piston valve replaced the plain flat valve in the h.p. cylinder in Fig. 2. There was no difficulty about this, as the earliest marine engine piston valves had outside admission, and this plan has advantages for a model engine, but the clearances might be even greater than in Fig. 2. To reduce these clearances Messrs. Rankine & Blackmore, of Greenock, fitted an intermediate lever, so that the h.p. slide valve could be placed closer to the cylinder, but, of course, this meant a reduction in the h.p. valve travel. This design, applied to a small marine engine, is illustrated in Fig. 3, but it does not appeal to me for a small engine.

Next, we will look at the tandem launch engines, made by Simpson, Strickland & Co.; how well I remember those lovely little launches, flying about Dartmouth Harbour, 50 and more years ago. I expect many readers are already familiar with these famous engines, so I have chosen an illustration, taken from an 1892 price list, of one in a lesser known form—as a portable steam engine. The smallest had cylinder bores of 2 in. and 4 in. × 4 in. stroke, and could develop 3 b.h.p. They seem to be pretty good value at £96, complete with boiler and carriage. Single-crank compounds are advertised with cylinder bores $1\frac{1}{2}$ in. and $4\frac{1}{2}$ in. × $3\frac{1}{2}$ in. stroke up to 5 in. and 15 in. bores and $8\frac{3}{4}$ in. stroke.

Two-crank compounds were listed, too, in the same sizes, plus an extra large one. I think, however, that the firm's favourite engine was the quadruple expansion set, consisting of two tandem units, side by side, with a double crank. They reckoned that their smallest quadruple, having cylinder bores, $1\frac{3}{4}$ in., $2\frac{5}{8}$ in., 4 in. and 6 in. diameter × $3\frac{1}{2}$ in. stroke, developed as much power (10 i.h.p.) at 175 p.s.i. as a single crank compound of $2\frac{1}{2}$ in. and $7\frac{1}{2}$ in. bore × $4\frac{3}{4}$ in. stroke at the normal 125 p.s.i., recommended for compounds. What wonderful value the little quadruple was at £73, and the compound £10 cheaper.

The first thing we note about the Simpson Strickland engine is its compactness for a compound. The

cylinders are separated by a diaphragm only, and the following quotation from their catalogue is, I think, of great interest: "The grade of expansion is directly proportioned to the area of the cylinders, and there is far less loss of pressure between them than is the case with most compound engines, owing to the shortness of the passages, and owing also to the fact that the temperature of the steam is maintained, during its passage through the valve, by the live steam, by which it is surrounded.

The steam is carried through 90 per cent. of the stroke in all cylinders, and consequently the crank effort is very uniform. The h.p. piston-rod has annular grooves, which prevent any passage of steam from the high to the l.p. cylinder. In no instance has any trouble ever been experienced with this form of piston-rod, nor has any leakage been found to take place between the two cylinders. That it is absolutely tight can be proved by demonstration, if required."

Well, I think that these catalogue notes answer a lot of questions, and it only remains to give a diagram of the Kingdon patent slide-valve, which I have drawn from memory. One valve serves for both cylinders, and the valve face of the h.p. cylinder is moved down as close as possible to the bottom of the h.p. cylinder, presumably to keep the valve short. There is no exhaust port in the h.p. cylinder, but a channel from the h.p. exhaust cavity led to the l.p. cylinder ports, so that one end of the h.p. cylinder exhausted into the other end of the l.p. cylinder, where the piston was ready to commence its stroke. I think that the action can quite easily be traced from my diagram (Fig. 4).

This system of compounding has not often appeared in THE MODEL ENGINEER and such engines are known as "Woolf" compounds. In the Simpson, Strickland engine there was only just sufficient lap to prevent a blow-through from steam to exhaust and, as previously stated, steam was carried for practically the whole stroke. The valve was in the form of a long oblong box with a lug on the bottom, which engaged with a button on the valve-rod.

I think that Simpson, Strickland's design has every element for success in a miniature compound, running under a steady load, and I very much regret that I did not follow their design, which I do not think would offer any difficulties in fabrication. Instead, I copied the design of the little tandem compound launch engine, made by the old City Road firm, Messrs. Whitney. The l.p. cylinder is nearest to the crank, and the valve-rod passes right through the l.p. valve-chest. The h.p. rod comes out at the back of its steam-chest and is connected to the l.p. by a yoke, which can just be seen in the photograph.

My engine has bores of $\frac{1}{2}$ in. and $\frac{13}{16}$ in., with a stroke of $\frac{7}{8}$ in. I originally intended to fit a long plain bush for the piston-rod, but I altered the design to the usual form

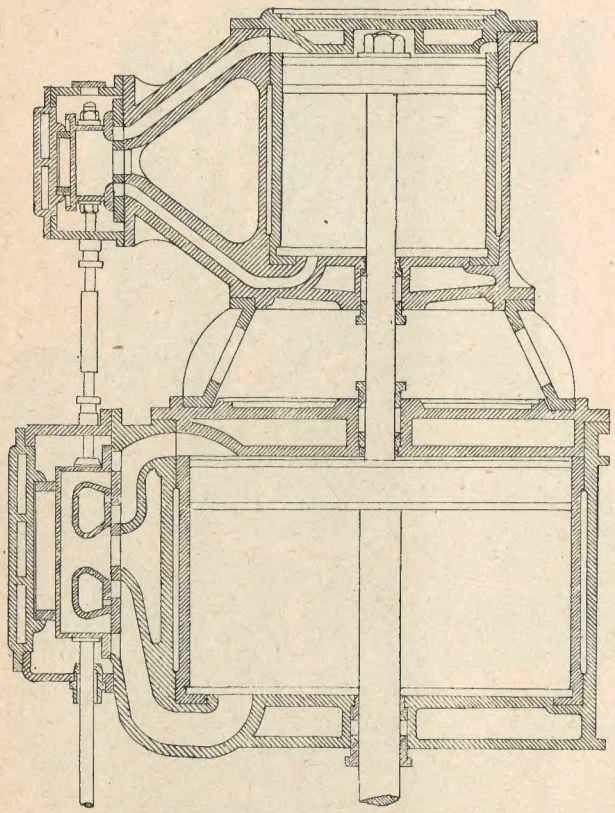


Fig. 2.

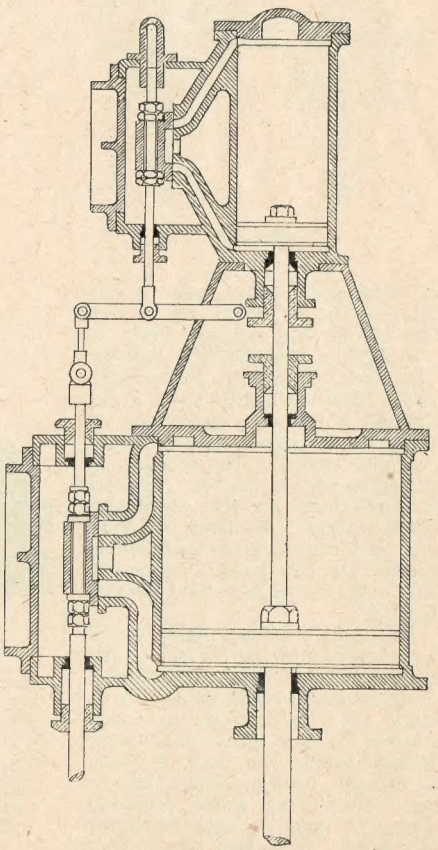


Fig. 3.

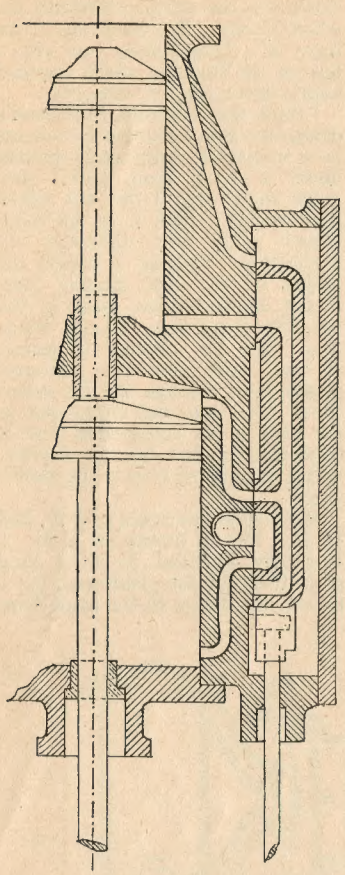


Fig. 4.

of screwed-in gland with a big diameter head, which pretty well fills up the h.p. cylinder bore, so that there is little clearance volume. The gland nut is screwed up tight, and a 10-B.A. c/s-head screw is put through it into the diaphragm, so I can see no reason why it should ever give trouble. The accuracy of the alignment of the two cylinders is maintained by the diaphragm between them. My lathe is a good one, and there was no difficulty in getting the two pistons concentric with each other so as to run smoothly together.

Of course, a marine engine should have a condenser and air pump, and the size of the latter was decided by what scrap I happened to have in stock, viz.: an eccentric and strap suitable for $\frac{7}{16}$ in. stroke and a piece of brass tubing $\frac{3}{8}$ in. bore. Rightly, or wrongly, I put no faith in ball or disc valves—they would probably stick if a good cylinder lubricator was fitted. It seemed to me that for reliability, mechanically operated valves must be fitted, and what could be better than an s.a. oscillating cylinder? This is put in a little hotwell tank, and is normally covered by water, that effectively seals off any leakage. The condenser was a keel condenser in the form of about 12 in. of $\frac{3}{16}$ in. copper pipe.

When tried from a stationary boiler, and fitted with a flywheel, it ran steadily and seemed to be economical. If it was running slowly with open exhaust it would immediately speed up, when the condenser and air pump were connected, and at slow speeds, most of the power seemed to be developed in the l.p. cylinder. At any rate, it stopped at once if the vacuum was broken, and that seemed to prove conclusively that the l.p. cylinder may do useful work in a small steam engine.

In the boat, it was too inclined to stall on dead centres, but when it did run, it drove the paddle wheels, about $4\frac{1}{2}$ in. diameter, at a furious speed. I have little doubt that it would drive a much bigger boat effectively, and that larger and heavier paddle wheels would overcome the dead centre difficulty. The boat in which it was tried was rather awkward, as the paddles are carried on separate shafts with a flexible coupling to the engine, so that the momentum of the paddles gave it little help.

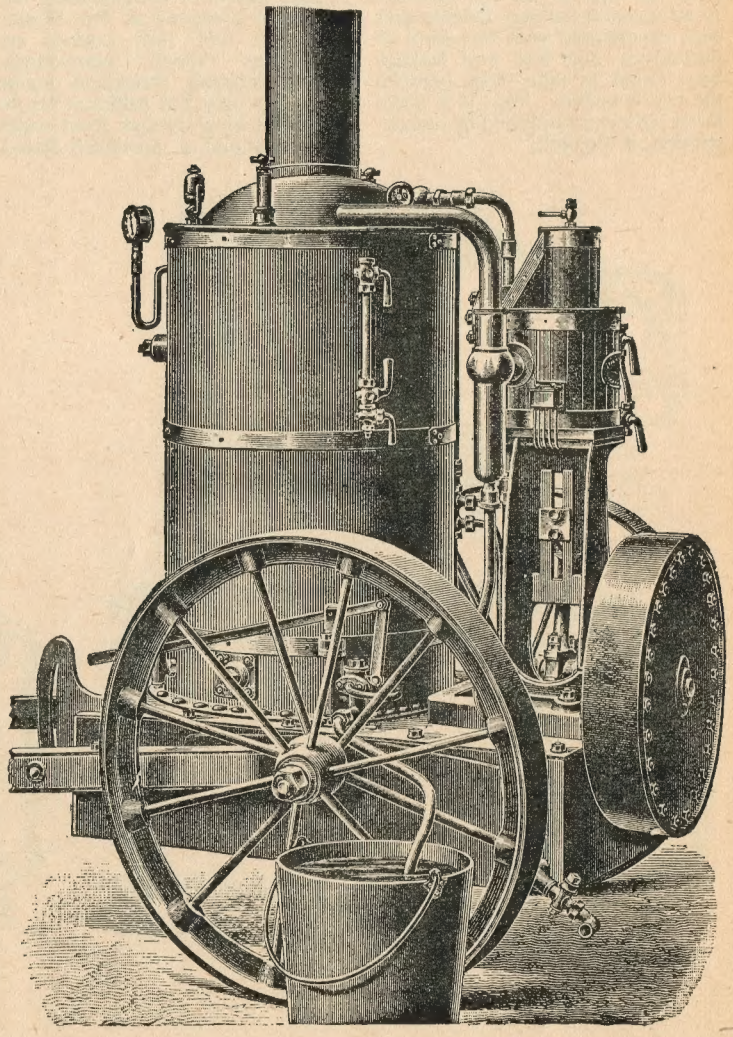


Fig. 5. *The Simpson Strickland tandem compound engine*

IN THE WORKSHOP
BY DUPLEX

Constructing an Electric Hand Drill

EXCEPT on the score of expense, the commercial electric hand drill has many advantages over its hand-operated counterpart, for the high rate of revolutions obtainable with the motorised tool makes for quick and easy drilling, without the need of excessive drilling pressure.

As several jobs had recently to be done where the work could not be taken to the ordinary drilling machine, it was decided to make an electric drill by using one of the surplus motors now on the market and fitting it with a drill chuck, suitable hand-holds, and a convenient form of switching gear.

The electric motor chosen was obtained at very small cost from Mr. Whiston, who advertises in this journal. This motor, of the series-wound commutator type, is of 1/3 h.p., intermittent rating, and is designed for an input of 24 V. The machine in question is a high-grade product, of superior design and workmanship.

Motors of this kind will run on either a d.c. or an a.c. supply, but the present motor is designed primarily for d.c. working; nevertheless, intermittent working is quite satisfactory, and overheating does not occur in these circumstances, when a 14 V or a 24 V current is supplied from a static transformer connected to the a.c. mains. Moreover, the deep-groove ball-bearings on which the armature runs are fully capable of taking the thrust load imposed when drilling.

In this particular type of motor there are two field windings, wound in opposite directions, in order to obtain reversal of the direction of rotation by switching in either winding. When describing a further application of motors of this type, directions will be given for re-connecting the field windings so as to obtain a greater power output and less heating effect.

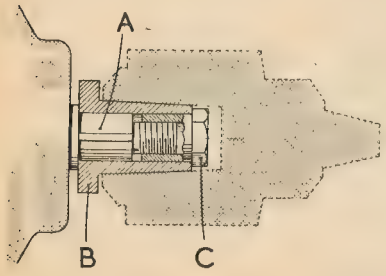


Fig. 2. The drill chuck mounting. A—the extension shaft; B — the tapered sleeve ; C — the retaining nut

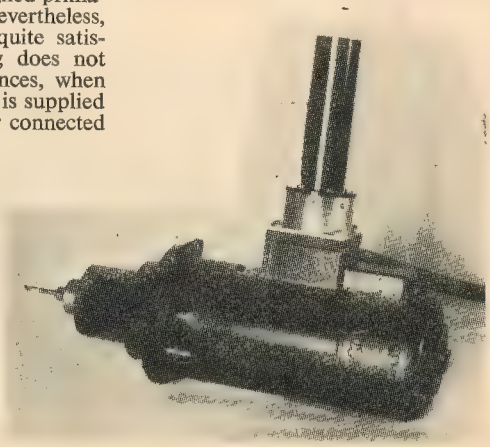


Fig. 1. The finished hand drill

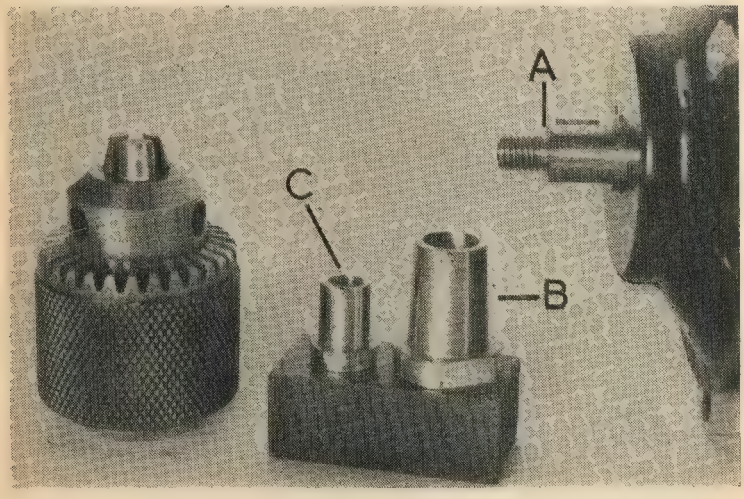


Fig. 3. Showing the extension shaft in place and the chuck mounting bush

Fitting the Drill Chuck

The driving clutch fitted to this type of motor is discarded and, instead, an extension-piece *A* is made a press-fit on the end of the armature shaft. An internal keyway is also cut to fit the existing shaft key.

As shown in Fig. 2, the coned sleeve *B* for mounting the drill chuck is keyed to the shaft *A* and is secured by means of the nut *C*. The drill chuck shroud *D* illustrated in Fig. 1, is secured to the end-plate of the motor, and forms a convenient grip for the left-hand when using the

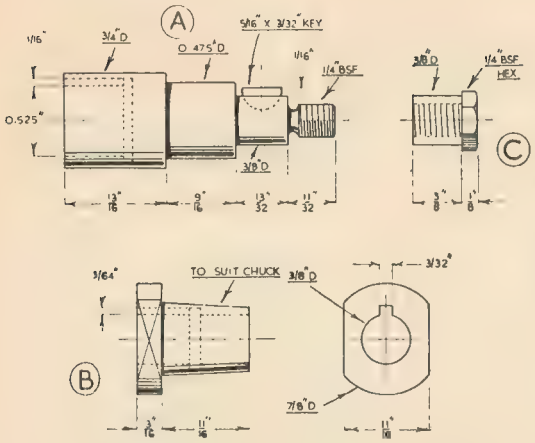


Fig. 4. Details of the chuck mounting parts

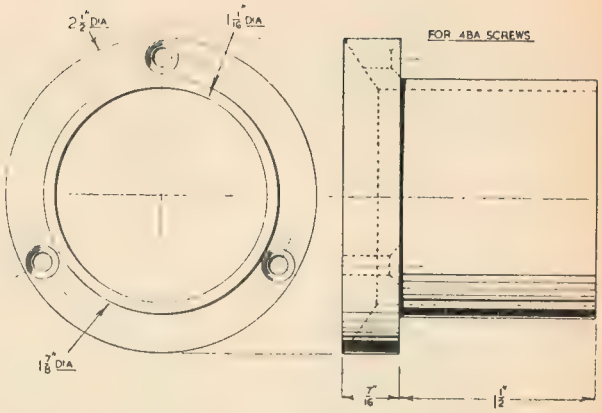


Fig. 5. The drill chuck shroud—D

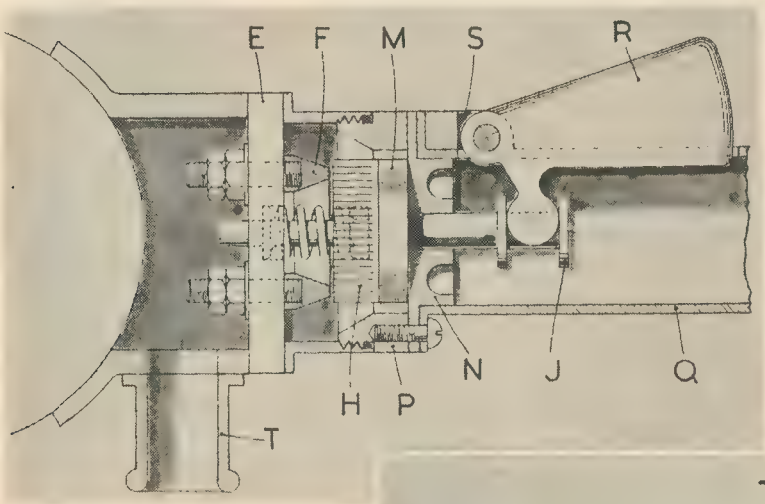


Fig. 6. E—the terminal block; F—the fixed contacts; H—the outer moving contacts; J—the operating spindle; M—the backing plate; N—the spindle bearing plate; P—the handle mounting; Q—the handle; R—the switch lever; S—the lever bracket; T—the cable grip

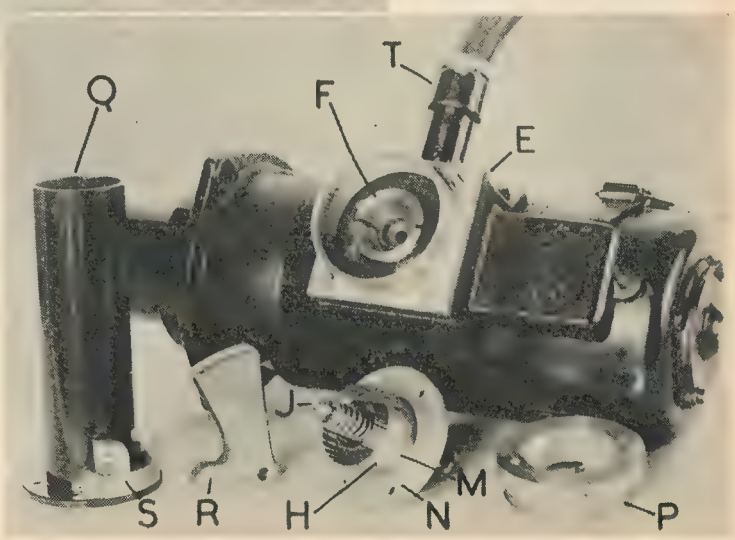
drill. The chuck fitted is a Jacobs drill chuck of $\frac{1}{4}$ in. capacity.

The Switch and Hand-grip

The existing threaded connector, fitted to the terminal box and designed to carry a wiring plug, is retained; but the terminal plate itself is replaced by the insulating plate *E*, which carries the two semi-circular switch contacts *F* and the terminal strip shown in Fig. 13.

The two serrated cups, *G* and *H*, forming the inner and outer, moving, switch contacts, are secured to the operating spindle *J* by the nut *K*, and the spring *L* serves to maintain the switch

(*Continued on page* 96.)



Right: Fig. 7. Showing the switch parts

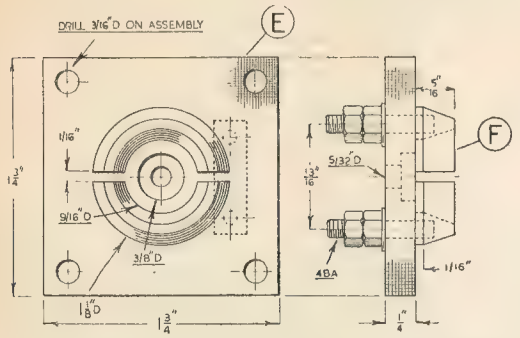


Fig. 8. The terminal block and fixed switch contacts

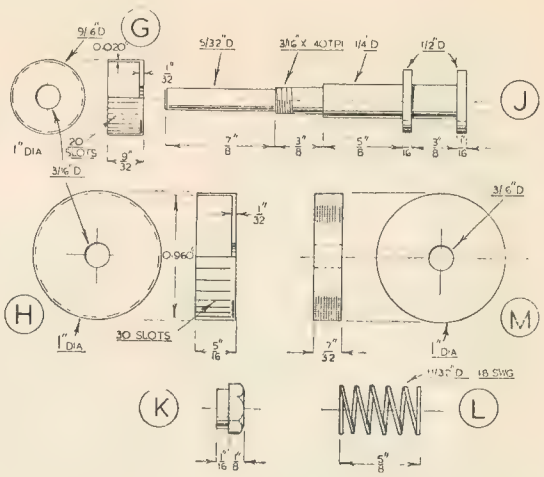


Fig. 9. The operating spindle and contact cups

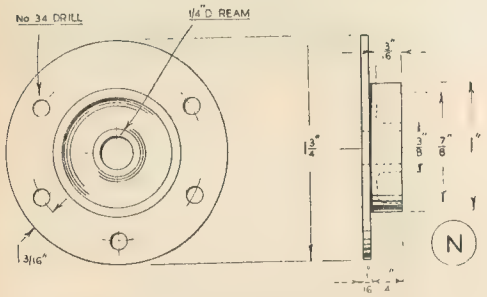


Fig. 10. The spindle bearing plate

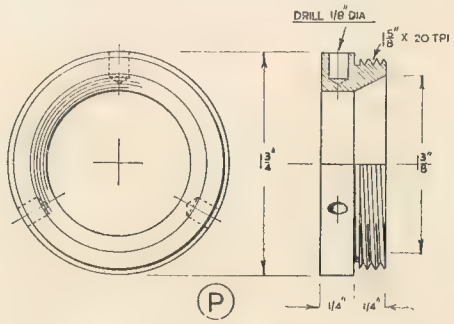


Fig. 11. The handle mounting ring

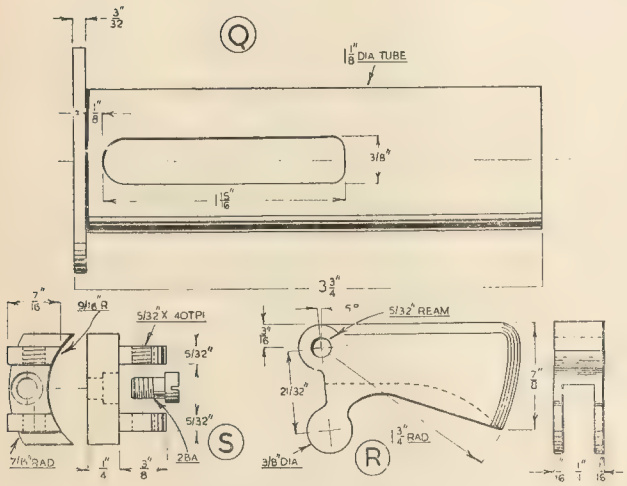


Fig. 12. The handle and switch lever parts

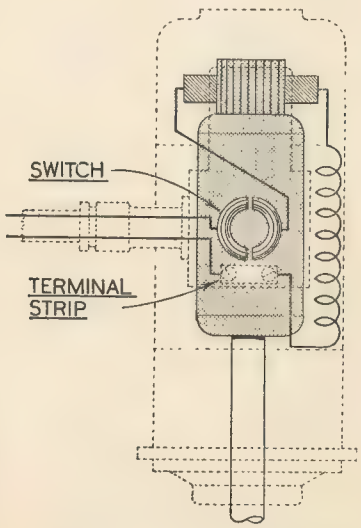
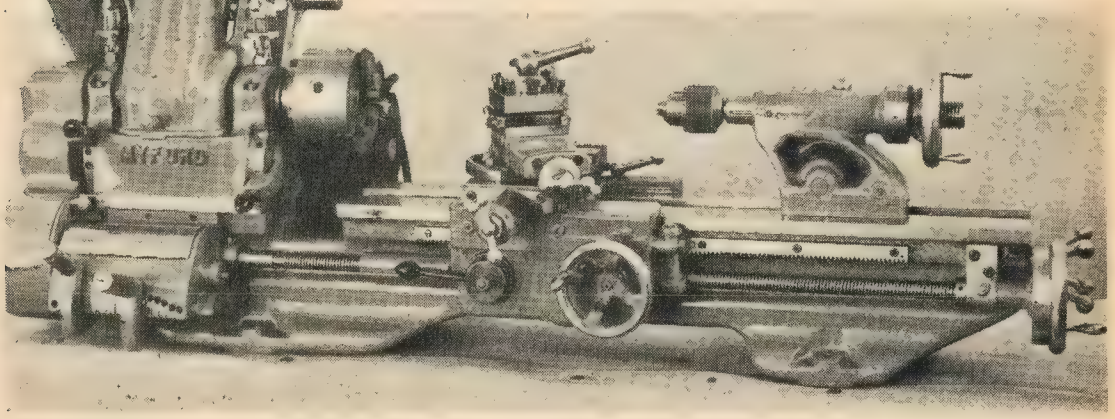


Fig. 13. The wiring diagram

A Multi-feed Gearbox

By Edwin A. Boosey (South Africa)



THERE must be other small lathe owners, like myself, who find the business of changing gears for screw-cutting and then to fine feed a tedious task when one is anxious to " get on with the job," especially if the nature of the work in hand entails two or three different pitch threads that must be screwcut.

My own version of the " Ideal Amateur's Lathe," always had a feed gearbox on it, even though it existed as a rather ambitious dream, so after one rather long spell of breaking down greasy gear trains and setting up others, I decided to try and materialise my dream of a quick-change gearbox.

Setting out my requirements, I found these to be:—

(1) I must be able to screwcut all standard British threads (comparable with the size of the lathe).

(2) Combine a range of turning feeds.

(3) The size to be in proportion to the lathe so as not to be ungainly or bulky.

(4) To fit the Myford M.L.7 without too much alteration of parts.

After thumbing through catalogues for illustrations of gearboxes on various makes of lathes, I noticed that some would not cut 19 t.p.i., which is $\frac{1}{4}$ in. and $\frac{3}{8}$ in. British standard pipe thread—threads which I had occasion to cut several times in the past, so I decided that my box would include this pitch.

As can be seen from the photographs, the range of threads cut goes from 4 to 240, the last row generally being used for turning feeds, giving 60 different changes. 50 of these feeds are obtainable by selection of the two levers on the front of the box, while the 10 coarse feeds entail changing a 20 tooth gear for a 40 tooth in the primary gear train (immediately below the tumbler reverse).

A little study of the engraved chart plate will show that each thread is doubled in each row, and this is done by an arrangement of gearing similar to the back gear of a lathe, only in triplicate.

After a few sketches had been made of a suitable gear arrangement, a case was drawn in around the gears, and from this a cardboard " mock up " was cut out and glued and tried up to the bed of the lathe. This told me that: First, it could be screwed to the lathe bed without much trouble, secondly, it would not be too long to limit the operation of the saddle when doing collet work close to the headstock, or too high to interfere with the tumbler gear and backgear engagement levers, and thirdly, that as the input and output shafts were in line and occupied the same position as the leadscrew, the existing gear quadrant could be used for the driving train from the mandrel.

The gear cover and plate normally used to guard the change wheels would remain the same except for a few minor cut-outs, and this seemed to me an ideal arrangement.

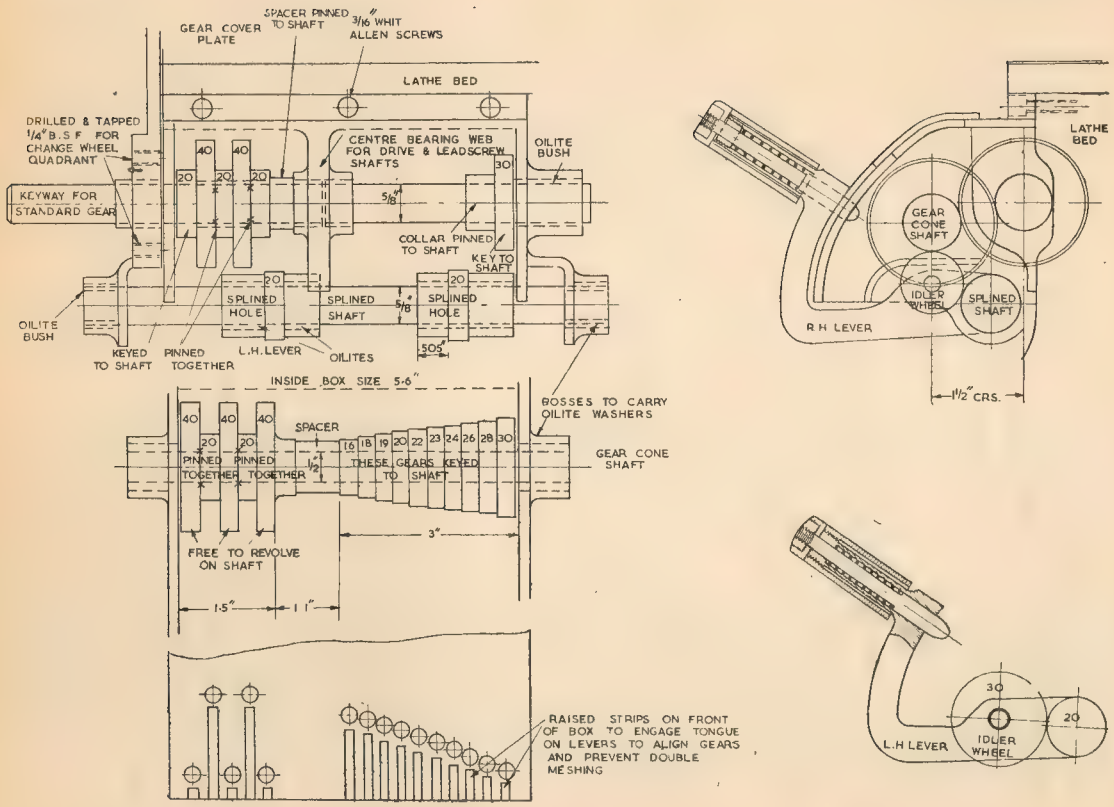
The cardboard pattern was used to mark out the plates for the box, which were built up from $\frac{1}{8}$-in. steel plate and welded together, with steel bosses welded on to carry bushes for the shafts. These bosses were then bored to size by means of a boring bar between centres.

Gear blanks were then machined (25 of them—a formidable task) and the teeth cut. Four shafts were turned, and one of these is splined for it's full length. In order to ensure that the two gears sliding on this shaft would fit accurately, I milled an extra length of material similar to the splined shaft which I afterwards grooved out in the lathe to form a broach. After hardening, this broach was pulled through the centres of the two sliding gears and produced a neat 6-grooved hole which was a good fit on the shaft. After a bit of working up and down with metal polish, a smooth sliding fit was obtained without wobble or side play.

Bronze bushes were made for the shafts, and for the double gears that revolve on the shafts, and oil nipples fitted.

The selector levers were now fabricated from mild-steel plate, although a casting would have been better, and the idler gears fitted. Bronze bushes were fitted to the bosses of the levers where they slide on the outside diameter of the splined shaft.

The handles are spring-loaded, the tapered plunger matching tapered



Side and end views, showing arrangement of gears, and detail of L.H. selector lever

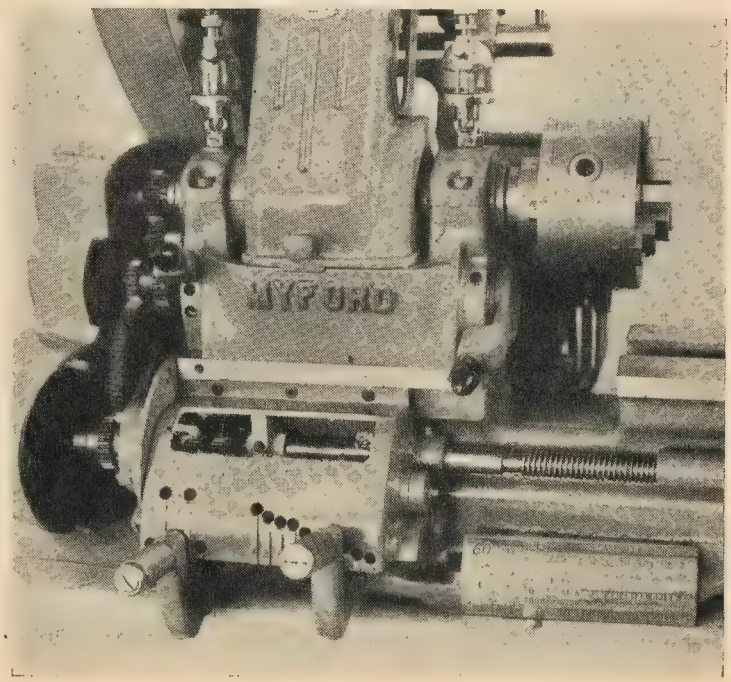
holes in the front of the case, these being drilled in alignment by actual meshing of the gears (making an allowance for clearance) through a jig bush fitted up temporarily in place of the plunger.

In fitting the box to the lathe, quite a lot of trouble was taken in ensuring that the shaft that is coupled to the leadscrew was dead in line, as it is essential that no straining or bending occurs when the clasp-nut is engaged.

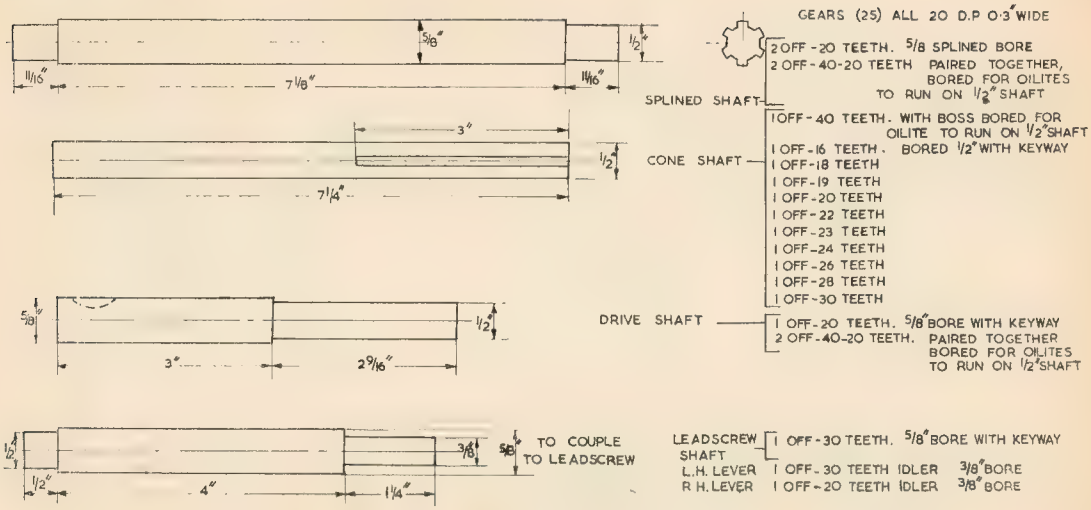
Three holes were drilled and tapped in the lathe bed just below the machined ways for holding the gearbox to the lathe, and clearance provided for the larger gears.

The leadscrew was cut and drilled to fit the "output" shaft with a shear pin provided.

Strips of stainless-steel were



Right: Close up of gearbox fitted to ML7 lathe


GEARS (25) ALL 20 D.P 0·3" WIDE
2 OFF - 20 TEETH. 5/8 SPLINED BORE
2 OFF - 40-20 TEETH PAIRED TOGETHER, BORED FOR OILITES TO RUN ON 1/2" SHAFT
SPLINED SHAFT
1 OFF - 40 TEETH. WITH BOSS BORED FOR OILITE TO RUN ON 1/2" SHAFT
1 OFF - 16 TEETH. BORED 1/2" WITH KEYWAY
CONE SHAFT
1 OFF - 18 TEETH
1 OFF - 19 TEETH
1 OFF - 20 TEETH
1 OFF - 22 TEETH
1 OFF - 23 TEETH
1 OFF - 24 TEETH
1 OFF - 26 TEETH
1 OFF - 28 TEETH
1 OFF - 30 TEETH
DRIVE SHAFT
1 OFF - 20 TEETH. 5/8" BORE WITH KEYWAY
2 OFF - 40-20 TEETH. PAIRED TOGETHER BORED FOR OILITES TO RUN ON 1/2" SHAFT
TO COUPLE TO LEADSCREW
LEADSCREW SHAFT
1 OFF - 30 TEETH. 5/8" BORE WITH KEYWAY
L.H. LEVER
1 OFF - 30 TEETH IDLER 3/8" BORE
R.H. LEVER
1 OFF - 20 TEETH IDLER 3/8" BORE

Details of shafts, and specification of gears

soldered to the case below each hole where the plungers fitted, and a grooved tongue fitted to the inside of the levers, so that in operation the plunger is guided to it's hole, which makes gear engagement easier.

Stainless-steel was also used for the chart plate, the numbers and letters being stamped and the lines scored, afterwards filled in with red paint. This plate is secured with two small spring clips, being easily removable so that oiling of the gears inside the box can be more readily carried out.

The time saved in use by this accessory to the lathe makes the undertaking of such a gearbox well worth while, although, of course, a lot depends on what type of work you do. Quite a lot of work is spoilt by drunken threads cut by a die when they should have been screwcut, and a quick change gearbox overcomes that temptation to leave those changewheels where they are and use a die.

CONSTRUCTING AN ELECTRIC HAND DRILL

(*Continued from page* 92)

in the open-circuit position. The plastic backing-plate *M* supports the switch cups, and the spindle *J* has a bearing in the cap *N*. The threaded collar *P* screws into the existing threaded connector and forms a mounting for the handle *Q*. The switch lever *R* is pivoted to the handle by means of the small bracket *S* which, as can be seen in Fig. 7, is secured to the flange of the handle with a single screw.

When the switch has been assembled, light finger pressure on the switch lever will close the switch and, as the grip is relaxed, the return spring will again open the contacts.

The Wiring

With the low-voltage current used, no earthing connection is needed. The tubular fitting *T* is attached to the side of the terminal box with four screws and is afterwards drilled to fit the supply cable. A turn of 18-gauge copper wire is wrapped round the end of the cable, so that when the nut is tightened, the wire is compressed and the cable becomes firmly held.

When working the motor at 24 V, the current may reach a maximum working value of some 20 amps.; the connecting cable should, therefore, be heavy enough to carry this current without becoming heated or causing a voltage drop. However, it will be found that, for ordinary drilling, plenty of power will still be available if the working voltage is reduced to 14 V, and there will then be less likelihood of the motor becoming heated.

When operating the drill, the clutch shroud is held with one hand, and with the other hand the side handle is gripped and the switching controlled.

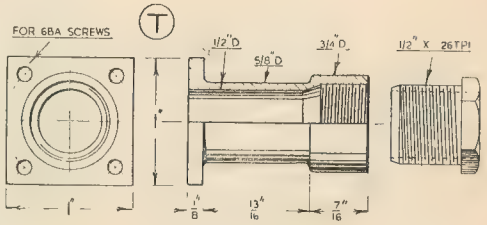
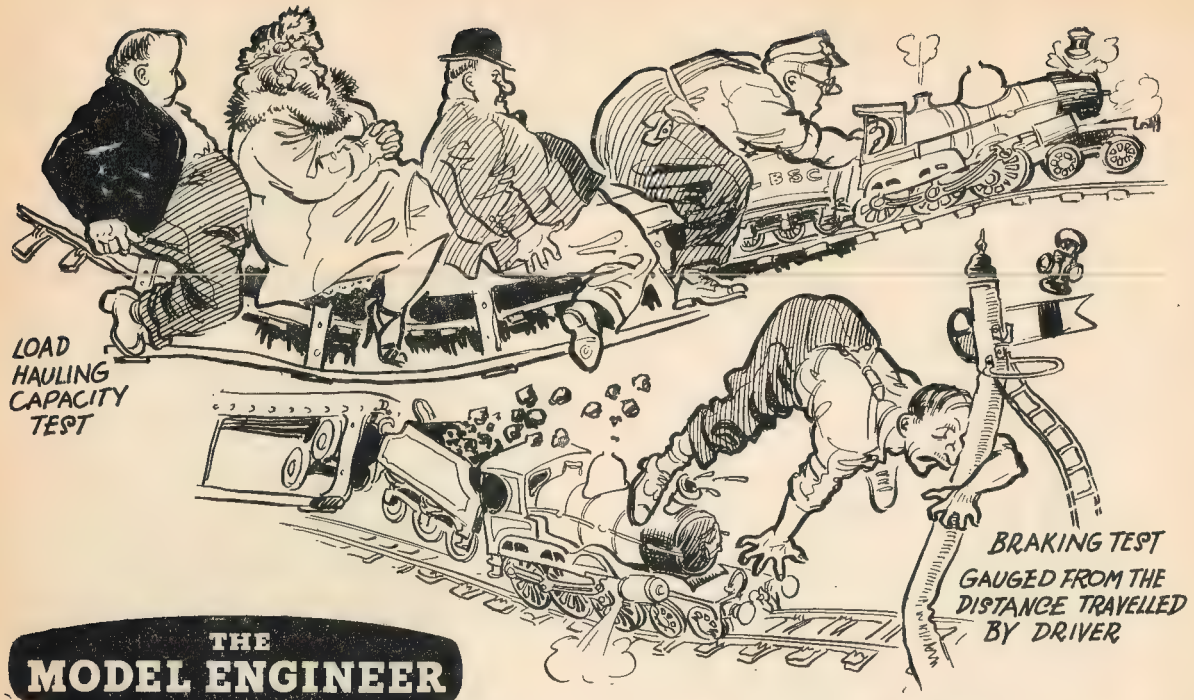


Fig. 14. *The cable grip*

The finished drill was found to be capable of drilling $\frac{1}{8}$ in. diameter holes in mild-steel with great ease, but when drilling $\frac{1}{4}$ in. diameter holes it is better to drill a pilot hole first.

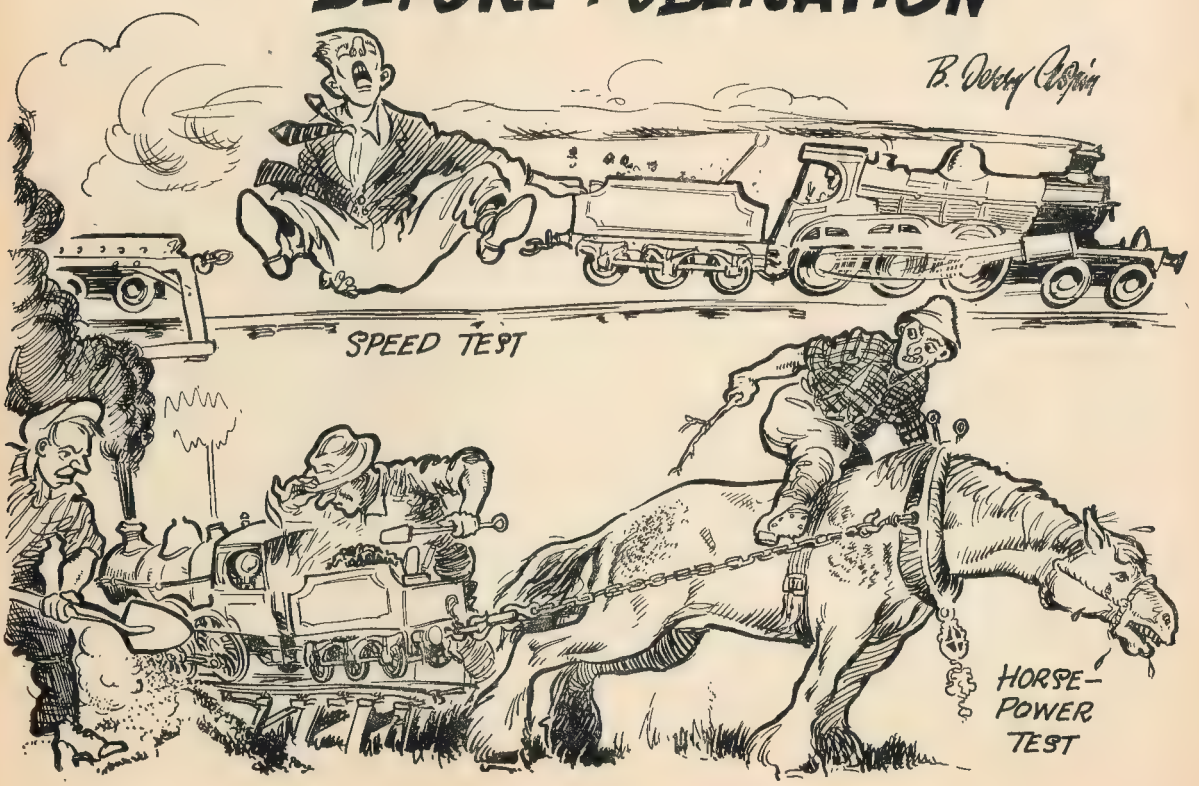
As the drilling speed is high, high-speed steel drills are preferable for use in the machine.

By making use of a spare Jacobs drill chuck, a reliable electric hand-drill was built from first-class components at a cost of only a few shillings.



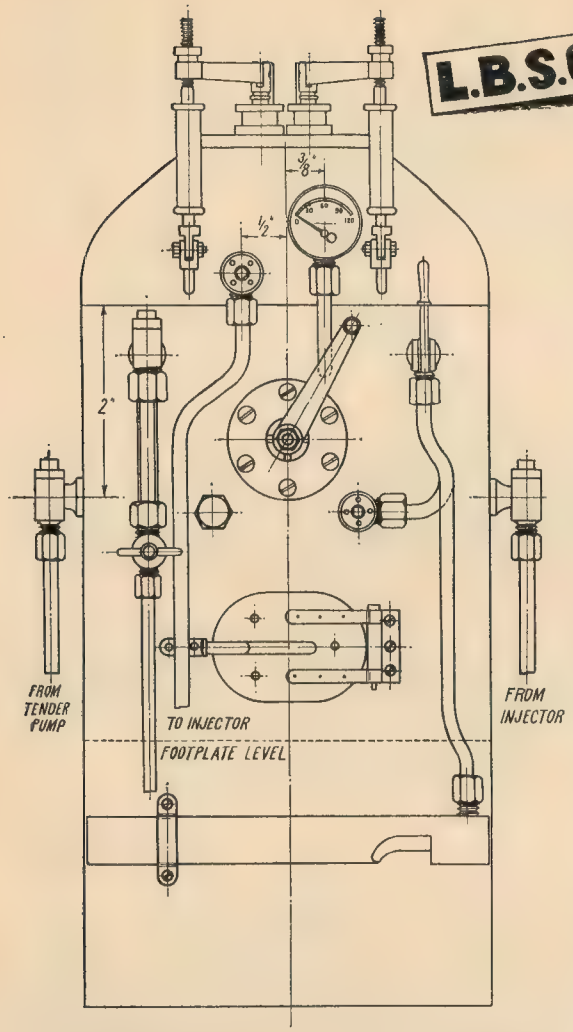
THE MODEL ENGINEER

TESTS A NEW LOCOMOTIVE DESIGN BEFORE PUBLICATION



L.B.S.C.'s Titfield Thunderbolt

THE BOILER FITTINGS



Arrangement of fittings (5-in. gauge backhead shown)

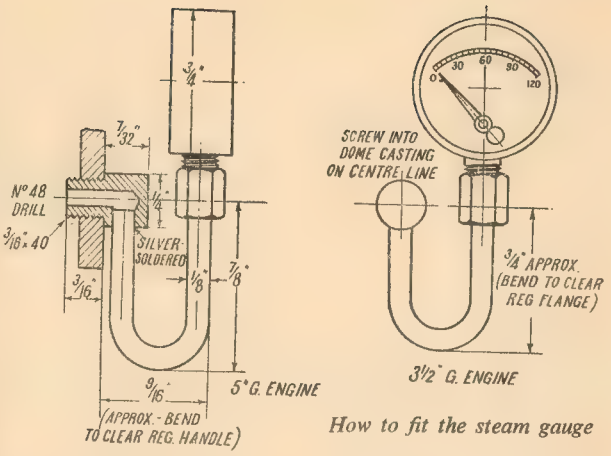
THERE wasn't much in the way of fittings on the backhead of the old "ancient and honourable," and so our small editions will appear to be a bit more thickly populated; but regular followers of these notes don't have to be reminded that Curly has a passion for neatness, and so I have tried to lay out the arrangement of the fittings so that they look nice, and are easily get-at-able. Despite some folks' obstinate assertions to the contrary, there is a limit of smallness in size, below which you cannot go, whilst retaining efficiency; I've already explained several times, the effect of capillary attraction on the truth or otherwise, of the water-level shown in a little gauge-glass. At the same time, there is not the slightest excuse for the clumsy outsize fittings shown in old commercial catalogues, and which still persist, even to the present day. My policy is to try to establish a happy medium: and the reproduced drawing of the backhead of the 5-in. gauge *Tit* shows how it can be done. The arrangement of the 3½-in. job is very similar The water-gauge mountings are the same size, using, a glass ½ in. shorter The syphon for the steam gauge is turned around parallel with the backhead, as shown in the detail sketch, to clear the regulator handle. Both whistle-valve turrets are the same size, ditto the side clacks on the firebox casing; but to avoid having a pair of big clacks on the side of the boiler barrel, I have shown a weeny clack, made somewhat after the same shape as those on not-so-big sister, which could be used on the 3½-in. gauge job, set just to allow the union nut to clear the leading splasher. The crosshead pump would feed through both of these "in parallel," as our Milly-Amp friends would say. I worked this wheeze on a very small locomotive that I once built in the days of long ago, and it worked fine. The two side clacks should be fitted on the firebox casing in addition, and used for the feeds from the tender hand pump and the injector. They are hidden by the side fenders.

The fittings follow my usual practice, and all can be made from rod material; I recommend a good quality drawn bronze or gunmetal, though hard brass would do at a pinch. Many of the old-timers had brass fittings; but don't use the alloy known in the trade as "screw-rod" if you can possibly get anything better. For joints, use either best grade silver-solder, or Easyflo, with the special flux sold for use with it. This can be obtained in wire form, which is about the handiest possible for these "jewellery jobs," as only the smallest quantity is needed for each joint, otherwise the fittings will look what the kiddies call "worse 'n awful."

To make the steam gauge syphon, chuck a bit of ¼ in. round rod in the three-jaw, face the end, centre, and drill down to ⅜ in. depth with No. 48 drill. Turn down 3/16 in. of the end to 3/16 in. diameter, and screw 3/16 in. × 40. Part off at a full 7/32 in. from the shoulder, reverse in chuck, skim off truly and chamfer slightly, for appearance sake, then drill a No. 32 hole in the boss, and fit a bit of ⅛-in. copper tube in it. This should be a full 1½ in. long for the 5-in. gauge engine, and a full 1¼ in. for the smaller one.

The steam gauges supplied by our approved advertisers are usually furnished with a nut and tail pipe, the latter having on it, the little cone which fits the end of the screw connection on the gauge itself. Don't use the tail pipe; instead, open out the hole in the union nut to take the pipe (No. 30 drill should do it) and make a fresh cone, in the way I have described many times already, from a bit of copper rod. Put the nut over the pipe, fit the cone, and silver-solder cone and boss connection at the one heating. Pickle, wash and clean up, then bend the syphon to the shape shown. The steam gauge should be about ¾ in. diameter for both sizes of locomotives; a larger one can, of

course, be fitted, but looks unsightly. The pressure range should be 0 to 120 lb. On the 5-in. gauge engine, at $\frac{3}{8}$ in. to the right of the centre-line, and $\frac{1}{4}$ in. above the joint between the firebox wrapper and the dome drill a 5/32-in. or No. 22 hole, and tap it $\frac{5}{16}$ in. × 40. On the 3½-in. engine, drill and tap the hole on the centre-line, at $\frac{1}{4}$ in. above the joint. Screw in the fitting with a taste of plumber's jointing on the threads, attach steam gauge to union, and adjust the bend of the syphon pipe so that the gauge sits up straight, as shown.

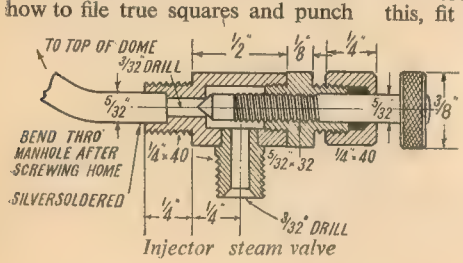


How to fit the steam gauge

Injector Steam Valve

This is of the quick-opening type to which I recently referred. Chuck a bit of $\frac{3}{8}$ in. round rod in the three-jaw, face the end, centre, and drill about $\frac{7}{8}$ in. deep with 3/32 in. or No. 42 drill. Open out for about $\frac{1}{4}$ in. depth with No. 23 drill. Turn down $\frac{1}{4}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40; part off at $\frac{1}{2}$ in. from the shoulder. Reverse in chuck, open out and bottom to a bare $\frac{7}{16}$ in. depth with 7/32-in. drill and D-bit, and tap the end $\frac{1}{4}$ in. × 40. Fit a $\frac{1}{4}$-in. × 40 union nipple in the side, halfway along, and about 2 in. of 5/32-in. copper tube in the counterbore, silver-soldering both joints at one heat. Chuck a bit of $\frac{3}{8}$-in. hexagon rod in three-jaw, face, centre, and drill a full $\frac{1}{2}$ in. depth with No. 30 drill. Turn down $\frac{1}{8}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40; part off at $\frac{5}{16}$ in. from the shoulder. Reverse in chuck, holding in a tapped bush; turn down $\frac{5}{16}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Open out the end of the centre hole to $\frac{1}{8}$ in. depth with No. 21 drill, and tap the rest 5/32 in. × 32.

The gland nut is made in the same way as a union nut, and needs no detailing out. The pin is a 1¼-in. length of 5/32-in. rod, which may be rustless steel or hard bronze, turned to a cone point at one end, screwed 5/32 in. × 32 for a distance of $\frac{5}{8}$ in. behind the coned end, and furnished with a little hand-wheel at the outer end. As I've described how to file true squares and punch square holes umpteen times already, we needn't go all over it again. The threads should be turned off for $\frac{1}{8}$ in. from the point of the cone. Assemble as shown, packing the gland with a few strands of graphited yarn, then mark off a point on the dome, about $\frac{1}{2}$ in. off centre-line, and $\frac{5}{16}$ in. above the joint. Drill 7/32 in. tap $\frac{1}{4}$ in. × 40, and screw in the fitting; the union nipple should hang straight down. Take off the dome top, or manhole, and pull up the pipe so that the opening at the end is as close to the top as possible.



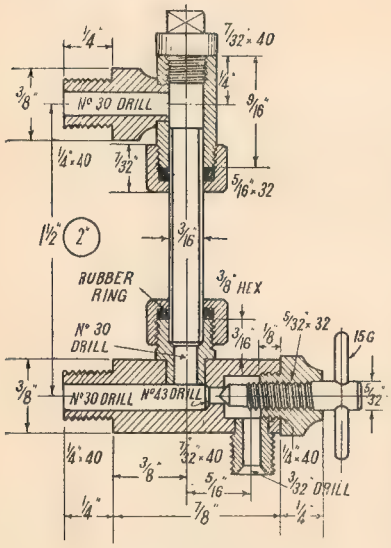
Injector steam valve

Water-gauge

The water-gauge is also of a type which I have described many times already, but it has a different kind of blowdown valve, which has a removable screw fitting, rendering it quick-acting, and less liable to become leaky through grit and scale finding its way on to the seating. If the fitting is periodically removed, and the recess cleaned out, leakage should be non-existent. The upper fitting of the gauge is a $\frac{9}{16}$-in. length of $\frac{5}{16}$-in. rod, with a few $\frac{5}{16}$ in. × 32 threads at one end, drilled right through with No. 11 drill, and tapped 7/32 in. × 40 at the other end. At $\frac{1}{4}$ in., from the tapped end, drill a hole about $\frac{3}{16}$ in. diameter, and in this, fit and silver-solder the fitting shown, which is turned from a bit of $\frac{3}{8}$-in. round rod. The distance from the shoulder to the centre of the hole through which the glass goes, should be $\frac{3}{8}$ in. The cap is turned from either $\frac{5}{16}$-in. round rod, the head being filed square as shown, which is the oldtime fashion, or it may be made from $\frac{5}{16}$-in. hexagon rod, and the top left the hexagon shape.

To make the bottom fitting, chuck a piece of $\frac{3}{8}$-in. round rod in three-jaw, face, centre, and drill to about 1¼ in. depth with No. 43 drill. Turn down $\frac{1}{4}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Open out the drilled hole to $\frac{3}{4}$ in. depth with No. 30 drill, and part off at $\frac{7}{8}$ in. from the shoulder. Reverse in chuck, open out the centre hole to $\frac{5}{16}$ in. depth with 7/32 in. drill and D-bit, and tap $\frac{1}{4}$ in. × 40 for about half the depth. At $\frac{3}{8}$ in. from the shoulder, drill a $\frac{3}{16}$-in. hole breaking into the centre hole, and in this, fit a $\frac{5}{16}$ in. × 32 nipple, drilled through No. 30 and counterbored with No. 11 drill, to carry the lower end of the gauge-glass. At $\frac{5}{16}$ in. farther along, and diametrically opposite, fit a 7/32 in. × 40 union nipple for the blowdown pipe. Silver-solder the two nipples at one heat.

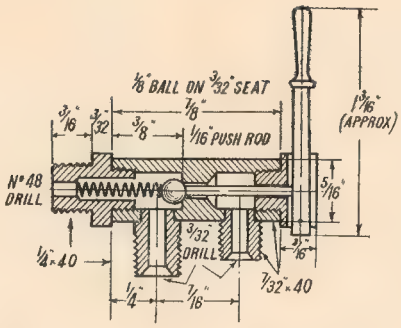
For the fitting carrying the valve pin, chuck a piece of $\frac{5}{16}$-in. hexagon rod, face, centre, and drill No. 30 for about $\frac{1}{2}$ in. depth. Turn down $\frac{1}{8}$ in. of the outside to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. May I here remind beginners, that if your die is what the kiddies call "a bit wonky," and doesn't cut a clean thread full length, turn the spigot a little longer than specified, screw in the usual way, then reverse the die in the holder, and run it on the spigot again, right up to the shoulder. This should give a good thread, and the spigot can then be faced off to correct length. Part off at $\frac{1}{4}$ in. from the shoulder. Reverse, and rechuck in a tapped bush; turn the outside to the shape shown, tap 5/32 in. × 32, and run a No. 21 drill in for about



Water gauge

3/32 in. to allow the threaded part of the pin to do the disappearance trick right inside the fitting. The pin itself is made in the same way as that for the injector steam valve, but is only $\frac{3}{4}$ in. overall length, and no gland is needed. Instead of a wheel, drill a No. 51 cross-hole, and drive a scrap of 15-gauge spoke wire through. This is a boon for tender fingers, as the valve can then be operated by an extension handle; just a bit of tube, any desired length, with a slot in one end to fit over the cross-pin, and another cross-pin, or a wheel, at the "fingers end." The gland nuts for the glass are made from $\frac{3}{8}$-in. hexagon rod, in a manner similar to union nuts. Top and bottom fittings are screwed into the bushes provided on the backhead, with a smear of plumbers' jointing on the threads; to make sure they are properly in line, poke the shank end of the No. 11 drill down the top fitting, and adjust both, until the drill falls of its own accord into the counterbore in the lower fitting.

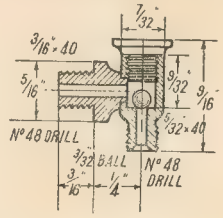
For beginners' benefit I might repeat that rubber packing-rings are easily made by putting a piece of rubber tube over a bit of $\frac{3}{16}$-in. round rod held in three-jaw. If the nut won't fit over it, run the lathe fast, and hold a bit of fine glasspaper to the rubber tube, which will soon teach it good manners. Then apply a wet discarded safety-razor blade to the rubber at about 3/32 in. intervals; and when you push the tube off the rod, it falls into packing rings. Cut a piece of $\frac{3}{16}$-in. glass tube to length by nicking with a fine file and breaking off. If you want a fancy glass, draw a fine red or blue line down it, with a drawing-pen charged with liquid paint, and when dry, back it with a wider white line. Insert in top fitting, put a wet ring on, then the two nuts back to back, then another ring; let the glass fall into the counterbore, push rings home and screw nuts in position. They need be little more than finger-tight, as the glass should be free to expand.



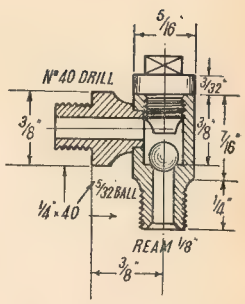
Blower connections and whistle valve

Whistle-valve and Clacks

The combined whistle-valve and turret differs but little from my "standard," and is made from a piece of $\frac{5}{16}$-in. round rod squared off at each end to $\frac{7}{8}$ in. length. Chuck in three-jaw, centre, drill through with No. 44 drill, open out and bottom to $\frac{3}{8}$ in. depth with $\frac{3}{16}$-in. drill and D-bit, and tap the end 7/32 in. × 40. Reverse in chuck and repeat operation, without using D-bit. Fit and silver-solder two nipples in line as shown, for blower and whistle pipe unions. For the cap, chuck a bit of $\frac{5}{16}$-in. hexagon rod, face, centre, and drill down $\frac{1}{2}$ in. depth with No. 48 drill. Turn down $\frac{3}{16}$ in. length to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{1}{4}$ in. from shoulder, reverse in chuck, and turn down the other end to 7/32 in. diameter for $\frac{1}{8}$ in. length, screwing 7/32 in. × 40. Open out the hole for $\frac{1}{4}$ in. depth with No. 30 drill. Poke a 3/32-in. reamer through the ball seat, and fit a ball and spring similar to that in the mechanical lubricator clack.



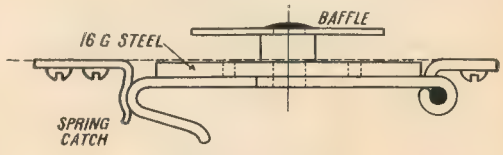
Special clackbox for the 3½-in. gauge engine



Clack valve for the 5-in. gauge engine

The lever fitting is simply a cap made from $\frac{3}{8}$-in. hexagon rod, the opposite corners being filed off the hexagon, to make it rectangular. It is drilled No. 51 for the pin, and slotted across $\frac{1}{16}$ in. full, for the lever, which is turned from $\frac{1}{8}$-in. rod, and the bottom part filed flat to fit the slot. The pin is just the head end of a domestic pin; the lever should work freely on it, and just depress the push rod enough to unseat the ball, and let a little steam pass. The complete valve is screwed into the bush on the backhead, which has the internal pipe leading to the dome. The larger union is connected to the union on the blower valve, by a $\frac{1}{8}$-in. pipe furnished with union nuts and cones, as shown on the view of complete backhead. A similar pipe is connected to the smaller union, and goes down to the whistle.

As I have described how to make clacks in full detail so many times, it is hardly necessary to waste space by repetition; the illustrations give all the dimensions, but just a word of explanation. For the larger engine, all four clacks should be made the same dimensions, though the outsides of the two on the boiler barrel can be made to the shape shown in the smaller sketch, for appearance sake. On the smaller engine, the firebox clacks are as shown, and the barrel clacks made to the given dimensions; but if preferred, they can be left out, and the feed pipe from the pump connected to one of the firebox clacks, see coming diagram. Next, boiler erection, grates, and ashpans.



Plan of firehole door

A Veteran Model Engineer

By "Hallam"

ANOTHER change—this time to ship models. The first of these was a paddle-tug, the *Cleveland*, built to ¼-in. scale with a hull 4 ft. 8 in. long. The prototype was owned by the Tees Towing Company, and besides performing her normal duties, she was frequently used as an excursion steamer. Mr. Hawkes built his hull from copper plates which were cut from an old scrapped clothes boiler; these were riveted and soft-soldered to each other and to the frames, the rivets being home-made from wire. Feathering paddles of 6¼ in. diameter are employed, having eight floats each. They are driven by a horizontal steam-engine through reduction-gearing. The boiler is of the twin-drum type, fired by spirits. Steering is from the wheelhouse, with kicking-springs fitted into the chains which connect the wheel to the rudder-bar.

Another of Mr. Hawkes' ship-models is based on a cargo-liner prototype, but is not quite finished. In this hull, the plates have been cut from phosphor-bronze sheet, and again are riveted and soft-soldered. They are correctly shaped as in the full-size hull, and there are thirty-eight ribs or frames. Fuel- and water-tanks are built in the hull.

Much deck detail has still to be made, but there are four hatches which are correctly battened down with tarpaulins and wedges. At present no steam-plant is fitted, but she has been tried out with a Stuart 10 engine. The boat will be finished off as time—and the mood—permits!

Continued from page 78, *July* 15, 1954.

Steam Again!

One of the most imposing of Mr. Hawkes' models was that of an industrial saddle tank engine built by Andrew Barclay and Sons in 1903. This had 16-in. cylinders, and was one of the heaviest ever built to run on four wheels only; it was—and still is!—immensely powerful.

The model is built to 1-in. scale, and is very heavy, like the prototype. It has pulled more than 15-cwt., and in its five years of life has been worked hard. Much of the turning, by the way, has been done by the builder's son Len, but Dad remarked jocularly that all the real donkey-work was left to him!

Castings for wheels and cylinders were also made by Len and a friend, Lance Bell of Thornaby, the metal being melted in a small cupola furnace they have built for this and similar work. It is capable of melting over 20 lb. of iron at a time, and Len showed me some very nice castings, including a large lathe faceplate, and the parts of a cone clutch fitted to the lathe-drive.

Returning to the locomotive, it is fitted with Stephenson link-motion, and the connecting-rods and coupling-rods both have split-brasses which are drawn up by wedge and screw.

Not having facilities for brazing or welding, Mr. Hawkes has made the boiler by close-riveting caulked by soft-soldering, though the tubes are silver-soldered in. Working pressure is 100 p.s.i.

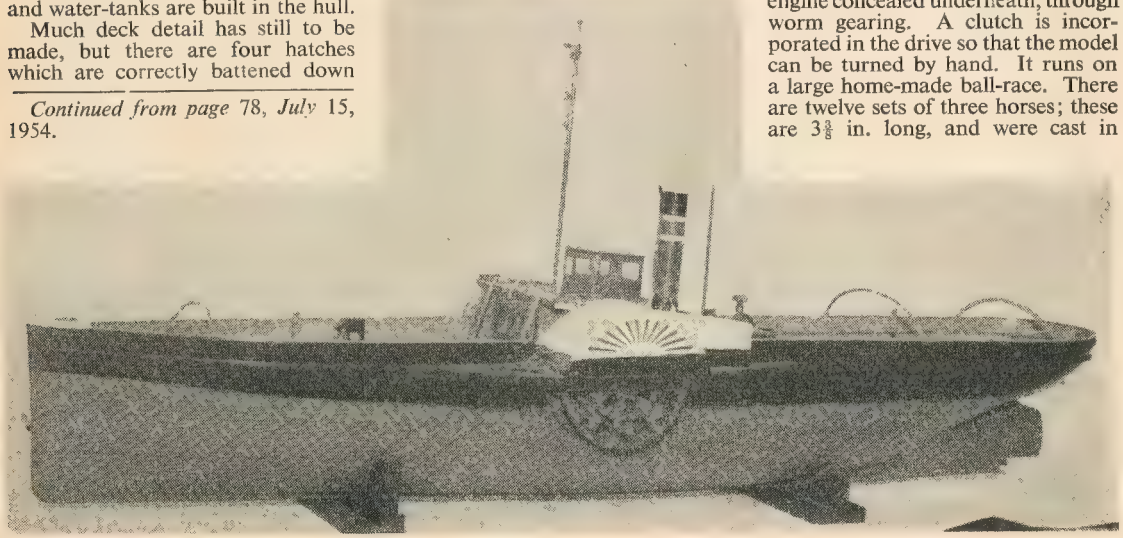
Detail on the engine includes working brake-gear, and there are sliding windows in the rear of the cab and hinged windows at the front. Neatly engraved nameplates and numberplates are on the sides of the tank, and a headlamp adorns the smokebox front.

Other Models

Many other fine models were shown to me by Mr. Hawkes, but in the space remaining to me it is only possible to describe briefly a few of them.

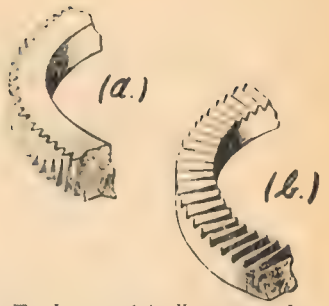
There was, for instance, a small model of a horse-drawn fire-engine, with manual pumps. This was about 15 in. long overall, with two pumps and pressure vessel. It is complete with suction and delivery hoses, and will throw a jet of water twelve or fifteen feet, as Mr. Hawkes insisted in demonstrating.

Then there was a model round-about 26 in. in diameter, with a dummy centre-engine—the model is really driven by a steam horizontal engine concealed underneath, through worm gearing. A clutch is incorporated in the drive so that the model can be turned by hand. It runs on a large home-made ball-race. There are twelve sets of three horses; these are 3⅜ in. long, and were cast in



Built to ¼-in. scale, this paddle-tug is a model of the "Cleveland," owned by the Tees Towing Company

Built to 1-in. scale, this is a naval gun on railway mounting as used for bombardment in the "Kaiser" war



(a) Teeth as originally arranged in gear-ring; (b) Teeth "turned" through 90 deg. to form contrate wheel

"Worm's-eye" view of the Barclay tank locomotive, showing the arrangement of the Stephenson link-motion

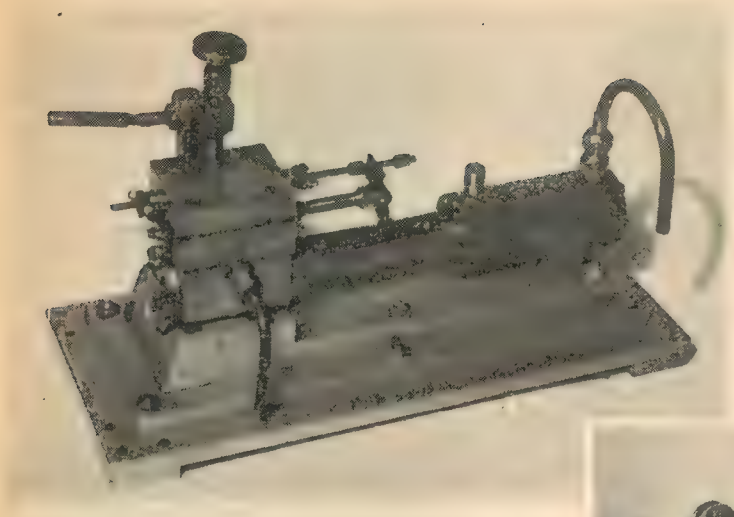
aluminium by Len Hawkes and Lance Bell from a pattern carved by the latter. Each of the twelve crankshafts which "gallop" the horses was built-up from 13 pieces silver-soldered together.

An Ingenious "Bevel Wheel"

An item which deserves special mention is the contrate gear-ring 7 in. in diameter, on which run the bevels at the inner ends of the crankshafts. This was made from a scrap gear-ring of about $\frac{3}{8}$ in. square section, which had its teeth cut on the outer rim in the usual way.

Mr. Hawkes cut the ring in one place, heated it, and straightened it out so that it formed a rack. He then turned it through 90 deg., and re-bent it to form a ring again, but this time, with the ring in a horizontal position, the teeth were on the *top* edge instead of the outside. Incidentally, this gave teeth of the correct

A model of an unusual prototype: a horse-drawn manual fire-engine which will throw a jet of water up to fifteen feet



Two Weir-pumps built by Mr. Hawkes; a single-cylinder horizontal and double-cylinder vertical

shape, wider in pitch on the outer diameter than on the inner diameter, owing to the inner edge being compressed and the outer edge being stretched as the ring was formed.

Yet another fine model was of a railway-mounted naval gun as used for bombardment in World War I. It was built for 5-in. gauge, and is 34 in. long with the gun itself 16⅞ in. long overall. The barrel is not rifled, but is arranged to fire a 0.303 rifle cartridge. It has an "interrupted thread" breech, and a spring-loaded recoil action. The mounting rotates on double ball-races, and is fitted with slewing and elevating-gear. Len Hawkes turned the barrel, on a treadle-operated 4-in. Drummond lathe. The well-wagon is of heavy construction, of course, and is fitted with a screw-jack at each end. There is also a cradle to support the gun-barrel when travelling.

Other models of Mr. Hawkes include a 5-in. gauge Atlantic locomotive based to a large extent on *Maisie*, with drivers 6⅞ in. in diameter, and cast-iron cylinders; an industrial 0-6-0 saddle-tank engine with Baker gear, which has pulled 15-cwt.; and a 7¼-in. gauge *Midge*, of which the chassis is well under way and the boiler complete.

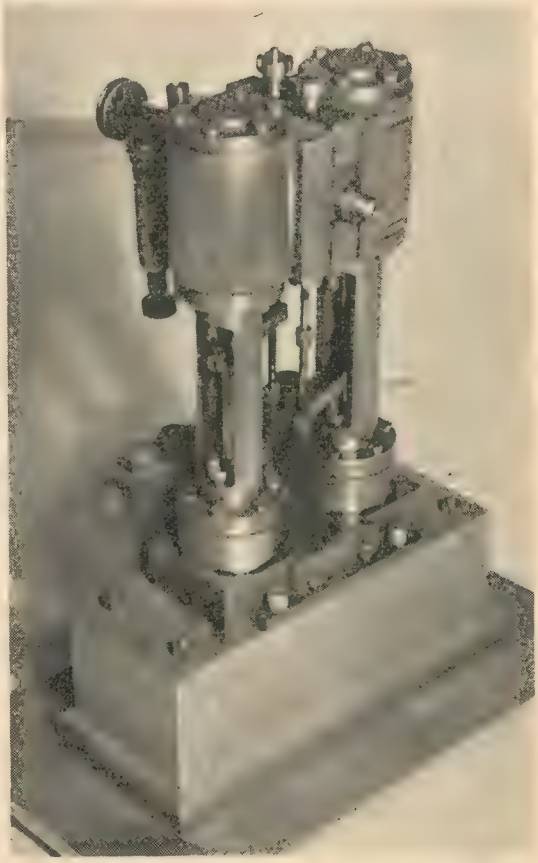
On the steam-engine side, I also saw two Weir pumps, one a single-cylinder horizontal type, and the other a two-cylinder vertical, as well as a compound marine-engine. And incidentally Mr. Hawkes has given quite a few models away at one time or another !

A Versatile Man

From what has been said, and from the illustrations, readers will gather that Mr. Hawkes is a versatile man, with a good old-fashioned belief in the value of hard work coupled with craftsmanship The workshop jointly occupied by father and son now contains a Little John 5-in. lathe and a "war-surplus" electric drilling - machine, but it seemed to me that even now the elder of the two yearned for the old days of the treadle-lathe and the hand-drill.

Despite his handicap of illness, Mr. Hawkes still keeps well occupied; together with his son he is making all the parts —rails, stretchers, tie-bolts and fishplates—for a 1,242 ft. long oval track, to 5-in. and 7¼-in. gauge. This is being erected by the local Urban District Council in a recreation ground, running on stressed concrete bearers on reinforced concrete posts. Evidently this council is more enlightened than many one could name ! This continuous track is the direct outcome of the success of a 150 ft. straight track that was erected for the Coronation, which with the aid of Mr. Hawkes's "Atlantic" carried more than 7,500 passengers between that happy event and the end of August.

Incidentally, the local authority is benefiting from Mr. Hawkes's activities in another way, for he is presenting to them a number of his models, complete with the glass cases he has made, to form the nucleus of an industrial museum. Until the time arrives when a suitable building can be erected or acquired, the models will be displayed in the foyer of the Council offices.



Mr. Hawkes must be warmly congratulated, not only upon his consistent energy, but also upon his foresight in arranging for the preservation of his remarkably varied collection of models.—EDITOR)

Electroforming Small Components

By R. H. Mapplebeck

The finished ventilator for deck mounting

THE heavy deposition of copper by electrolytic action has a ready application in model engineering, where it is desired to fabricate small hollow components of an awkward shape, such as ships' ventilators.

The principle involved is to make a pattern out of wax, and use this to make a mould in plaster of paris.

A low-temperature melting-point metal is cast in the plaster mould and subsequently, when cool, is electroplated to the thickness required, the metal being remelted and run out, leaving a hollow shell.

The author of these notes, desiring to make some deck fittings for a model launch, decided to try this method, and the results proved so satisfactory that it has been thought worth while to pass on the information to others of the fraternity who may like to have a go at this somewhat unusual though fascinating procedure.

The Wax Matrix

First of all, about eight ordinary wax candles were melted down, the wicks removed, and the molten wax cast in a small tin of sufficient volume to cover the size of the proposed component.

It was found that the wax, on cooling, shrunk to some extent and it was a simple matter to remove the solidified block from the tin by means of a few sharp taps.

The next step was to carve out the component's outside shape in the wax by hand, with a penknife or some other convenient tool. This was found fairly easy to accomplish on the whole, especially the ventilators, photographs from books or magazines providing suitable guidance.

One wax matrix was used for each component, but ingenuity will no doubt suggest to the reader methods by which the same matrix could be used for a number of castings. For instance, the plaster mould could be carefully sawn through as in the photograph, so that repeated castings could be produced, due allowance for the width of the sawcut being made by suitable packing.

Care must be taken in handling the wax whilst carving, or it will become warm and lose its shape.

The Plaster Mould and Casting

Some plaster of paris was made up with cold water in a cocoa tin, to a consistency suitable for casting, and the wax carving was pushed in just level with the surface. When the plaster had hardened, it was heated in the oven (the wife was out at the time) until the wax melted, which was then poured out, leaving a plaster mould of the shape desired. This mould was then used for making the metal casting, which was carried out with "Cerrobend" or "Wood's Metal" which will melt in boiling water, but is quite solid at room temperatures. No doubt lead would do equally well but would be more difficult to handle on account of its higher melting point.

Having poured the molten metal into the mould, a piece of wire with a hooked end was lowered into the melt and kept in position until it had solidified, a matter of a few minutes only.

The plaster was then broken open (or carefully sawn through as desired) releasing the solid metal component shown in the accompanying photograph. This was filed up and polished, and here let it be emphasised that a good polished surface is absolutely essential if the finished product is to be smooth.

The Plating Bath

The wire projecting from the casting was now used to suspend the component in the plating solution whilst electro-depositing the copper, which was carried out as follows.

The plating bath can be any suitable glass or glazed earthenware vessel, but must definitely not be metal on account of the acid. A two-pound glass jam jar was found to be just the job and this was filled about two thirds full with the following solution.

Copper Sulphate—32 oz. or 200 gms.

Potash Alum—2 oz. or 12 gms.

Pure Sulphuric Acid—9 oz. or 56 gms. by weight, or 5 fluid oz. or 31 c.c.s by volume.

Distilled water—1 gallon or 1 litre.

The two measuring systems are given for convenience, and, of course, there is no need to mix up more than say, one pint of solution, though the above proportions must be adhered to.

To allay the fears of the timid, it should be mentioned that during the plating process there is no heavy gassing or creeping of the solution or its salts; the process is quite clean.

As previously mentioned, the specimen was lowered into the solution by means of the cast-in wire and kept in position by hooking it over a piece of wood placed across the mouth of the jam jar. This formed the cathode or negative electrode of the bath, whilst the positive electrode or anode consisted of a heavy copper plate about 2 in. $\times$ 4 in. $\times$ $\frac{1}{8}$ in. connected by a piece of 12-s.w.g. copper wire.

A source of direct current was connected to the bath (negative to the specimen and positive to the copper plate) at a potential of six volts, the

current being regulated to pass about half an ampere.

It can be left to the individual to devise a means of regulating the current, which should be at a density of about 15 amps per square foot area of specimen to be plated. A few turns of resistance wire suspended in the leads, or a small lamp, should prove adequate. The source of direct current was a small 5-ampere hour accumulator, connected to a charger, so that it could be left working indefinitely without draining the accumulator, as this process of copper deposition took 48 hours plating to deposit 50-thous. of copper, roughly one thou. per hour.

If a sufficiently large accumulator or other direct current source is available, the charger, of course, will not be needed.

Every few hours the specimen should be turned on its hook so that a different side faces towards the anode in order to obtain a more even distribution of the copper.

Another point to bear in mind is that the current density should not be increased in the hope of speeding up the process, as this will only result in inferior plating or a spongy deposition of the copper. The slower the process, the more efficacious the result. Also, it may be found that if carried for too long a period there may be a tendency to produce a growth of nodules on the specimen. Nothing can be done then but to halt the process.

It will be noticed that the more copper deposited, the more will the anode become eaten away, since it is the source of copper, the solution only acting as a conductor, which was the reason for using a heavy gauge anode plate and connecting wire. It does not matter about the wire suspending the specimen, as that will become coated with copper where it is immersed in the solution, but a suitable gauge wire to use is say, 18-s.w.g. copper.

After about 48 hours, the specimen was removed from the bath, and thoroughly washed in hot water, after which the suspension wire was cut off, and the copper which had been deposited on the neck filed away to expose the " Cerrobend." The specimen was then put in a container of water and brought to the boil, whereon it melted and ran out, leaving a hollow copper shell.

The rough parts were filed away, the whole being rubbed up with emery paper, and finally polished as required with metal polish

Although this process may seem complicated, it is really quite simple, and it produced a very strong and lifelike ventilator, as shown in the photograph.

A Diversion

Whilst on the subject of " Cerrobend " it has been used by the author with great success for bending small copper pipes and tubes. It is only necessary to put a bung in one end of the tube to be bent, melt up some " Cerrobend " and pour it into the tube, making sure that the tube has first been coated with oil on the inside to prevent the molten metal sticking on withdrawal.

To make sure that the molten metal has settled down in the tube properly without solidifying in lumps, the tube should be heated gently whilst in a vertical position either by playing a flame up and down the tube or by holding it near a source of heat so that it can be kept at about 100 deg. C. It should not be overheated, or the alloy will deteriorate.

When cooled the tube is virtually solid, and can be bent very easily without kinking, and it only remains to re-heat the tube and run out the metal.

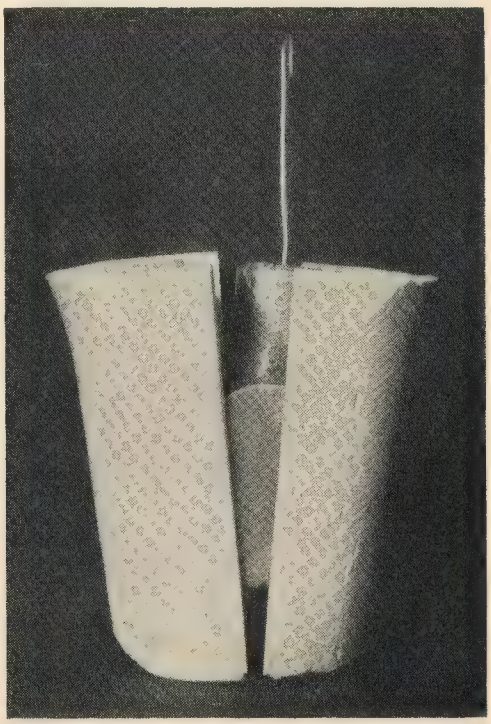
Conclusion

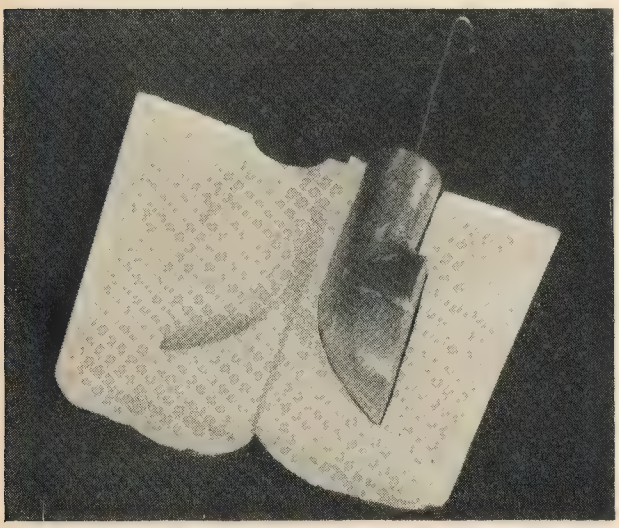
Although a ventilator has been mentioned, many other fittings have been made successfully by this process. Being copper, they are very suitable for boats, and as they are hollow, are very light, and may be painted or not as desired. Also, they can be soldered or otherwise handled like any other ordinary copper fitting, as far as the thickness of the shell will allow, so that with small threaded studs soldered to their underside, a means of fixing is obtained.

Thanks are due to Mr. M. Townley of St. Albans, who kindly took the photographs.

Right—Prising apart the halves of a plaster mould reveals the metal casting

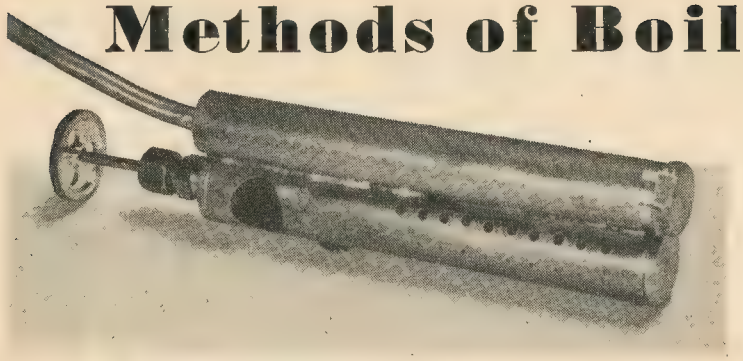
Below—Showing the " Cerrobend " casting in the mould. Note the cast-in wire for suspension during plating





MORE UTILITY STEAM ENGINES

Methods of Boiler Firing



One of the experimental diffused flame vaporising burners

By Edgar T. Westbury

WHILE the type of blowlamp burner which has just been described is capable of a wide range of application for boiler firing, not to mention its possibilities as a brazing torch, or for general heating purposes in the workshop, it is not the most suitable or efficient burner for firing a water-tube boiler, or other type of boiler in which a fairly spacious furnace, and generating elements mainly or wholly above the burner, are employed. For this purpose, a type of burner which gives a softer but more voluminous flame, directed upwards instead of forwards, is generally more efficient; such burners have often been described in THE MODEL ENGINEER for various purposes, including locomotive firing, but they are not as popular as they deserve to be, possibly because their working principles are not very well understood, and errors in their design or construction have sometimes resulted in partial or complete failure. The early steam cars, however, often used burners operating on similar principles, and I know of at least one full-sized river steamboat in which one is employed with complete success, not to mention a number of model boats.

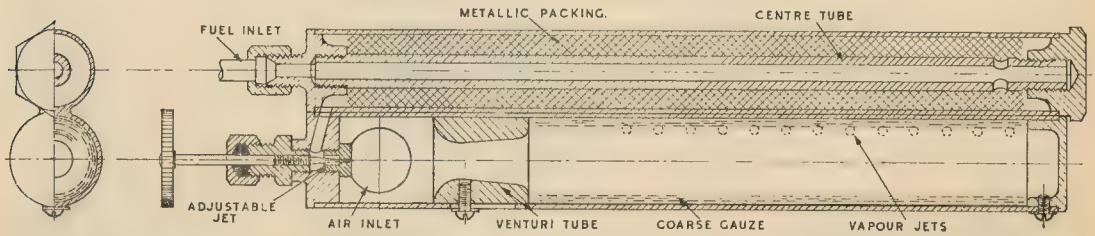
Continued from page 46, July 8th, 1954.

These burners, apart from other merits, are much less noisy than the torch type, and are often classified as the silent type, but this term can only be used in a relative sense, as many of them produce a very aggressive hiss when working at full bore; I prefer to classify them as " diffused flame " type burners. A design of burner which I have used in the past with great success was described in the previous series of articles on "Utility Steam Engines" and is also featured in the " M.E." handbook *Flash Steam.* This is of the cylindrical burner tube type, best suited to a fairly long furnace, and has a single looped vaporiser tube, leading to a variable jet arranged in concentric alignment with a venturi tube so as to inject air into the mixing tube, to form a rich combustible mixture with the vaporised fuel. This is allowed to escape at relatively low pressure from holes or slots in the mixing tube, the diffusion being assisted by coarse gauze loosely rolled inside the latter, and burns as multiple jets of flame, at a rate which enables externally-induced air to mingle with the flame and ensure complete combustion. Such a burner is much more amenable to the effects of forced and induced draught than a torch burner and less affected by obstructions in the path of the flame; the fuel can be fed in the usual way, that is, by air pressure in the tank, but " self-pressurising " by the expansion of the fuel when warmed, also direct force pump feed, has also been successfully employed, and gravity feed is practicable when the tank can be located at a fair height above the burner, to obtain sufficient pressure head.

I may mention that an adaptation of one of these burners by one of my friends has been used very successfully as a picnic stove, and is stated to work well in the open air, being less affected by draughts than the usual type. The idea that these burners are only suitable for specially selected fuel is refuted by experiments in which they have been proved capable of using any fuel from alcohol to paraffin, provided that suitable adjustments are made in the size of the jet and the area or location of the vaporising element.

A New Burner Design

With a view to increasing still further the versatility of the diffused flame principle, and also simplifying construction, I have evolved a new burner design which has given very good results in a variety of applications. No doubt some readers may



General arrangement of burner

have seen burners operating on somewhat similar principles, and, therefore (as usual) I do not claim complete originality for the basic idea; but at least the details have been independently worked out by careful experiment. Briefly, the salient feature is the use of a vaporising element in close metallic contact with the mixing tube, so that conduction of heat is rapid and even, and a form of construction which enables it to be completely dismantled for cleaning.

Constructors of blowlamps often concentrate on making the vaporiser as efficient as possible in its function as a heating element, using a considerable length of tube in the form of a coil, and locating it so as to become as hot as possible. While this principle is generally sound, and the majority of blowlamps made by these constructors seem to work reasonably well, it may not occur to them that it is possible to defeat one's purpose by making the element too efficient or getting it too hot. The function of a vaporiser is to heat the fuel up to something above the temperature of its heaviest constituent, but if it is made much hotter than this, a good deal of trouble can be caused by carbonisation of the fuel, resulting in hard carbon formation, and oxidisation of the metal, to form scale. Both forms of solid matter rapidly build up to obstruct the free passage of fuel, and when dislodged, to clog the jet. It is clear that some form of temperature control to the vaporiser would be very desirable, but it is difficult to conceive of any simple device which would achieve the desired result.

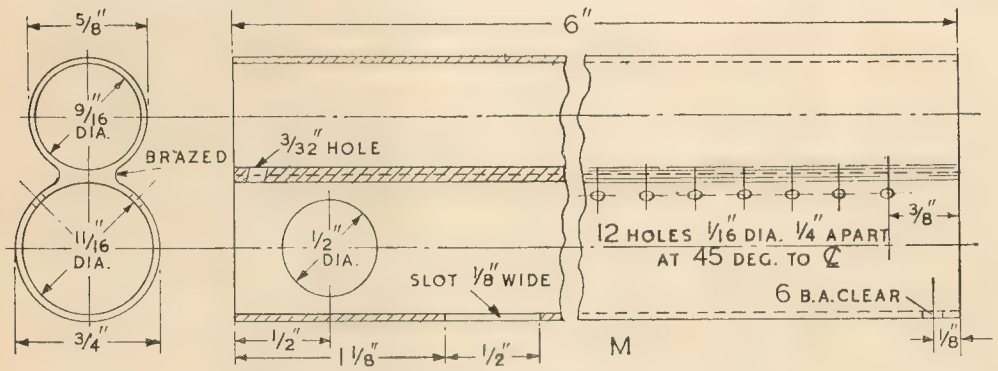
In this type of burner, however, the intimate contact of the vaporiser with the mixing tube does produce, if not a definite temperature control, at least some compensating effect. This is because the mixing tube, although receiving the hot vapour from the vaporiser, has a considerably greater volume of cold air passing through it, which produces a cooling effect. Thus the greater the volume of vapour injected, and consequently the fiercer the flame, the more cold air will pass through the mixing tube. Another point is that the length of the jets of flame from the latter, which produce the major heating effect on the vaporiser, varies according to the output, and has a relatively greater influence on the latter when they are short and soft than when they are long and fierce.

Construction of Burner

The lengths of copper or bronze tube for the mixing tube and vaporiser respectively should first be faced off truly at each end, and to exactly the same length, prior to brazing them together throughout their length. They may be secured in position by drilling holes close to each end to take staples of thick copper wire clinched tightly with pliers, but these must of course be filed away afterwards. Further security may be obtained by binding with thick iron wire at two or three places along the length, but the end fastenings are essential to preserve true alignment. It is advisable to use brazing alloy of fairly high melting point for this joint, not only to ensure that it keeps its strength at high temperature, but because it helps in building up a substantial fillet, which is not easy to do with silver-solder, on account of its narrow range of plasticity between the solid and liquid states. The complete burner tube assembly is shown in detail *M*.

Parts *A* and *B* in the detail drawings should preferably be turned from drawn gunmetal or bronze rod, though brass is permissible as a substitute. The machining is straightforward and calls for no comment, except to note that the screwed union on the outside of part *A* is optional; the fuel pipe could be brazed in, and this has been done in the burner illustrated in the photograph, but the union joint is an added convenience in fitting. Both parts should be a good fit in their respective tubes.

A radial hole is drilled at an angle of about 15 deg. in part *B* to connect the vaporiser with the jet nipple, and this must of course line up with a hole drilled in the burner tube, care being taken to avoid wandering of the drill which might cause leakage when the component is brazed in.



The combined vaporising and mixing tube assembly

Silver-solder is quite satisfactory here, and if the surfaces are coated with borax paste or other liquid flux, the metal will penetrate the joint everywhere. To prevent risk of filling up the communicating passage, a short piece of graphite from an ordinary lead pencil may be inserted in it, but don't forget to push it out afterwards. Access to the inner side of the joint can be obtained by drilling the side air inlets in the tube beforehand; a twist drill of the specified size is *not* the tool to use here, and I find that drilling a small hole first and opening it out by gradual stages with drills, or better still, reamers, is more satisfactory.

Part *A* may also be permanently brazed in, but this is not a necessity, and it may be preferred to leave it capable of removal if an extra pressure joint is not objected to. Part *C* is similar to *A*, but has a blind end and a deeper thread. It may be found necessary to skim the end face of the tube, to ensure a perfect seating for this part (also

part *A* if removable), and it may be lightly ground in with brick dust or pumice powder before fitting the centre tube (Part *L*). Part *D* is simply an end cap to close the mixing tube, made a neat push fit, and held by one, or possibly two, 6-B.A. screws in the side.

The Vapour Jet

An adjustable jet has been used on this burner, mainly because it facilitates experimental work, especially with different fuels, but a fixed calibrated jet orifice is equally practicable, and a Primus type nipple, as recommended for the previous burner, may be fitted if desired; conversely, the arrangement shown here may be applied just as effectively to the other burner. Parts *E*, *F*, and *G* may be made in brass, and are straightforward turning jobs, but it is necessary to take great care to ensure external and internal concentricity of threads and other register surfaces. My usual practice is to utilise glands and other internally screwed parts, while still set up in the lathe, to serve as screw chucks for mating parts, as this saves a good deal of work and simplifies the job; but where this is not possible or convenient, it is not a difficult matter to chuck a piece of scrap material, and drill and tap it in position to serve the same purpose. The union nut (part *L*) is identical with the gland nut except in detail dimensions. Part *G* does not call for "second operation" chucking, as it can be machined all over essential surfaces at one setting; it may have flats on the head like a Primus nipple (as illustrated) or be made from hexagon material; in either case a long box spanner or special key will be needed to screw it in, and it is convenient to be able to use a standard tool for the job.

The stem of the needle valve *H* should be made of stainless steel if obtainable; some knitting needles —but by no means all—are now made in this material, and in a size suitable for screwing 7 or 8 B.A. Turning the point to an included angle of 10 deg. may be a rather tricky operation, but can be done with care and patience, and it is permissible to finish off with a fine pivot file. Make sure that the needle is truly chucked for this job. Note that the thread on the needle does not extend long enough to reach the gland, the guide being drilled out to clear the thread at the outer end, so that the packing bears on the smooth part of the needle. Incidentally, cotton packing well impregnated with soap is the best packing I know for petrol or paraffin valve glands.

The handwheel may be screwed on with a very tight thread, or silver-soldered. I find that attempts to avoid burnt fingers by using a fibre wheel or a coil of wire soldered to the rim are not very successful, as the one always gets charred or becomes loose, and the other gets melted off sooner or later. A large wheel which can be manipulated with a bit of rag or a gloved hand will serve best; after all, one does not have to keep on using this valve (flame control should be effected by a valve in the fuel line, or by altering blowlamp pressure) and the fact that the jet adjustment is liable to be a trifle warm may be a blessing in disguise if it discourages twiddling !

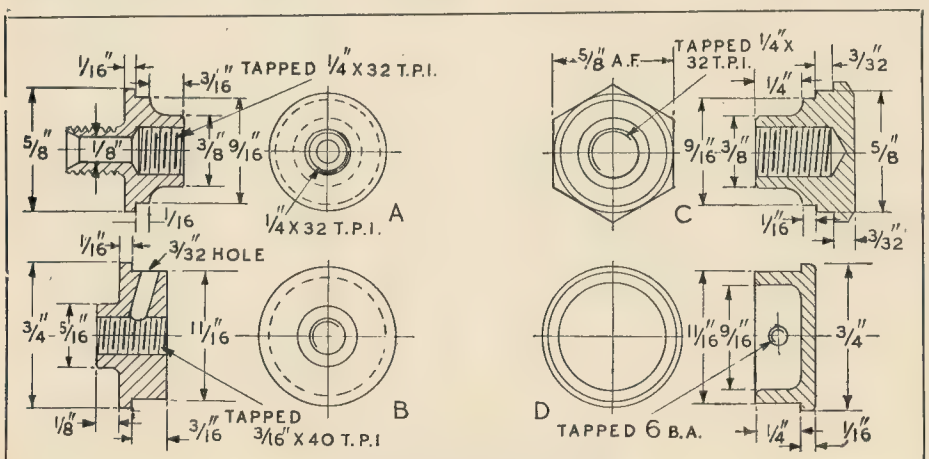
Venturi Tube

This is turned from brass to an easy sliding fit in the mixing tube, and the inside is turned to an included angle of about 10 deg. with a well-rounded flare at the entry. The size of the bore may be open to experiment, but it is important to note that the expanding jet of vapour should fill the bore, and if it is made too large, its effect as an injector will be very much impaired. Increasing the distance from the jet to the venturi will remedy this to a certain extent, but don't forget that the vapour is losing velocity all the way.

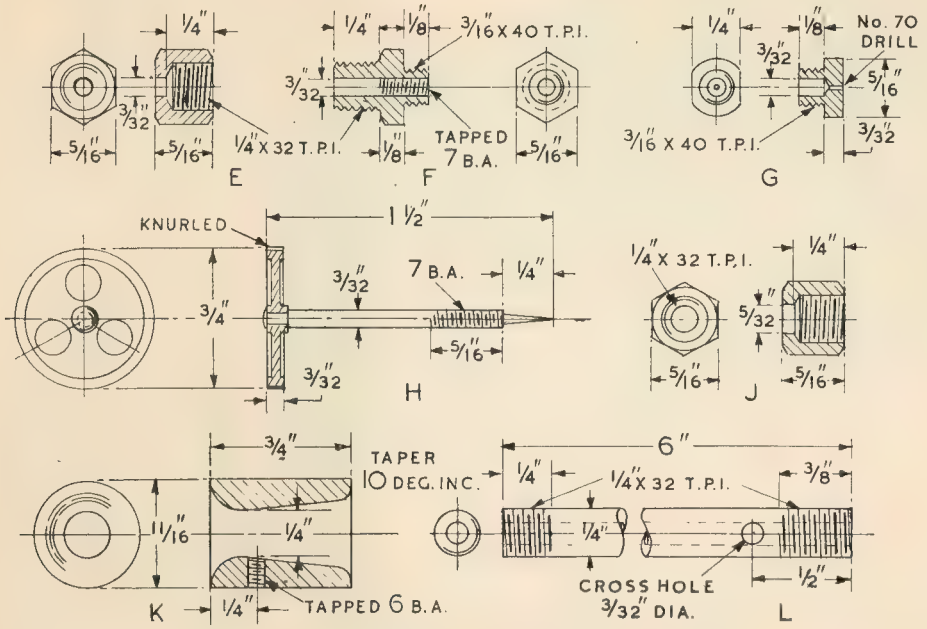
It is generally accepted that the natural expansion of a steam or vapour jet makes an angle of about 1 in 6, and the size and position of the venturi may be checked by making a template forming a complete cone of this angle at the end. When this is inserted in the mixing tube, with the point located in the jet, the throat of the venturi tube should make contact with the sides of the cone. In practice, however, some slight variation in the position may be found desirable, hence the slot in the mixing tube for lateral adjustment of the venturi, with the screw to lock it in position.

A loose annular coil of gauze or perforated metal is fitted in the burner tube to assist intermingling of air and vapour, and lower its velocity at the flame jets. In the absence of this provision, the flame is liable to be all at the end of the tube, and increase of fuel pressure may cause it to be blown right off the burner, making a futile and brief attempt to ignite in mid-air. Some of the weird combustion effects which have been described to me by blowlamp constructors may be caused in a similar way, and may usually be analysed by a little hard thinking, if basic principles are grasped.

In the first of these burners constructed, I packed the vaporiser tube with asbestos string, which worked fairly satisfactorily with alcohol or other fuels of very low boiling point, but much more effective vaporisation was obtained by packing it with strands of copper



Details of burner tube fittings



Details of the adjustable jet, venturi tube, and centre tube

wire (odd lengths of stranded cable stripped of all insulating material) or a roll of fine copper gauze. The latter is preferable, as it can be removed in one piece for cleaning, and the carbon, dirt and gummy residue can be burnt off in a bunsen burner prior to replacement.

It will be noted that the centre tube *L* serves as a tie-bolt, in addition to a fuel passage, enabling the cap (or caps) to be screwed firmly home against the narrow face joint on the burner tube; a little varnish or gold size helps to ensure a good seal. Don't forget to drill the cross hole in the tube, and to locate it at the right end. Thick-walled tubing is necessary here to ensure a strong thread and adequate tensile strength to resist stretching. I have specified 32 t.p.i. here in preference to 40 t.p.i., but this is optional, so long as the constructor is satisfied that the thread he uses will serve the purpose.

Choice of Fuels

Benzolene, "white" petrol or "High-flash" fuel is recommended here as combining high calorific value with clean working; they are relatively simple hydrocarbons as compared with some of the highly complex "cracked" modern motor fuels, and therefore not so liable to selective distillation when heated, so as to carbonise or leave residue in the vaporiser. The reason why paraffin (kerosene) is so often condemned as a "dirty" fuel is because the temperature range between gasification and carbonisation is narrow, but if it can be heated just sufficiently in the vaporiser and no more, it burns as cleanly as any other fuel, and is certainly of high calorific value.

Generally speaking, the higher the boiling point of the fuel, the greater will be the pressure which must be applied to mix the vapour with air so as to ensure good combustion; consequently in a burner of given size, a smaller jet orifice is necessary for paraffin and similar fuel than for lighter hydrocarbons. If petrol is used in a burner designed or adjusted for paraffin, and at the same pressure, the flame will often be blown right off the burner, though this is much less likely in a diffused flame burner than a torch; increasing the jet size will usually improve matters in this respect.

Alcohol, in the form of methylated spirit, methanol or wood spirit, demands the lowest feed pressure and the largest jet orifice of any fuel, with the possible exception of ether, which is rarely used anyhow. This is not only on account of its very low boiling point, but also because it is capable of complete combustion with a much smaller quantity of oxygen than other fuels. It is the easiest fuel to burn without making smoke or soot, and works well in "self-pressurising" or gravity feed burners, but even under the best possible conditions, and without regard to the amount of fuel consumed, it is almost impossible to obtain such a high heat efficiency with it as with petroleum derivatives. One peculiar property of volatile fuels generally is that their latent heat of evaporation causes them to absorb heat at the moment of ignition (this is most prevalent in wick lamps) and, thereby cause the flame temperature to be lower than would otherwise be obtained.

Modern motor spirits usually contain additives, ranging from tetraethyl lead or top lubricants to weird chemicals with cryptic names or initials, savouring of the rites of the ancient alchemists. Whatever their merits when used for their designed purpose in petrol engines, these substances can be a distinct nuisance in a blowlamp burner, and my experience suggests that such fuels are best avoided.

(*To be continued*)

The Salisbury Exhibition

Mr. Tamplin's tank is seen here in action

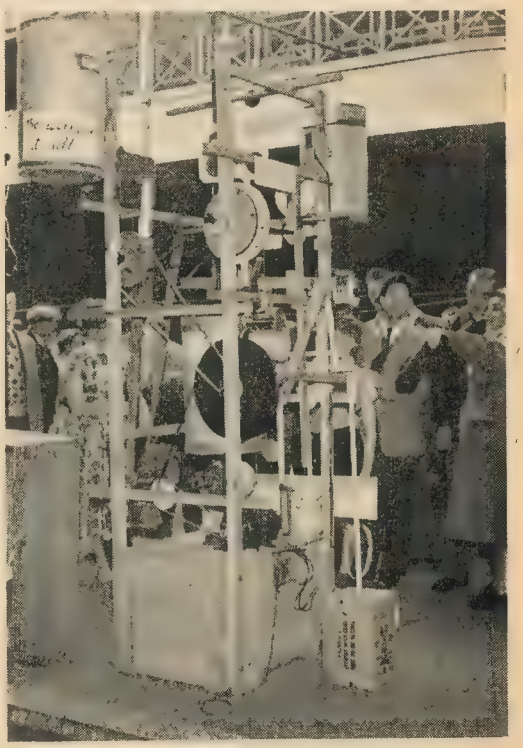
THE society's policy is to provide plenty of varied items and movement so as to attract the general public, who very often do not fully appreciate a finely-made model. At the 1954 show a 40 ft. × 30 ft. space was set aside, in which Mr. A. T. Tamplin's radio-controlled Churchill tank was demonstrated at intervals, and the imaginary " George " gained a well-earned round of applause after each performance, though at first there were one or two difficulties caused by interference from the steel framed building and from harmonics from one of the radio transmitters operated by the local Short Wave Club, who had a very interesting display including transmitters, receivers, and a film show. The arena was also used for round the pole model car racing and model flying—it was at first intended that members should fly ½-c.c. control-line aircraft in the usual way, but it was found that they became too giddy using the short 12 ft. lines, so Ron Marsh stepped into the breach and produced at very short notice a special pylon and control column so that the models could be flown from outside the circle, and though none of the aero-modellers had ever tried this method before, one in particular—Roger Dibb, a junior—soon became proficient.

Sharing the limelight with the tank was a hilarious " smoke grinding machine " perpetrated by Mr. G. D. Lovell. This unique contraption attracted large crowds, who looked at it in wonder which later changed to great amusement. The machine defies description; suffice it to say, that it was an 8 ft. high erection of wood and steel conduit, with pulleys and countershafts driven by knotted string and elastic, wavering dials, a " ring impulse generator " which blew wonderful smoke rings, a large pair of navvy's boots which marched solemnly up and down and a dilapidated pair of ladies' sandals which flapped; a high speed " engine " made of four matchboxes in which the trays acted as pistons; a large cylinder with jiggling valves and leaky glands; other cylinders (old tin cans) oscillating or revolving at high speed; while all the time a rhythmic tattoo was beaten out by two other cans of different sizes, and two large cardboard drums overhead slowly circled the machine, emitting smoke.

Some attractive fairground equipment was exhibited by B. Tutt of Salisbury, comprising a working set of gondolas—of which a striking feature was the beautifully executed miniature oil paintings of pastoral scenes adorning each panel—a showman's engine, living wagon, and a peep show " The Haunted Tavern."

A 1913 A.C. car, believed to be the only one in existence, which was rescued from a nettle bed and fully restored by H. J. Crabb, was a centre of interest with its shining brass radiator and acetylene lamps, together with a 1909 Minerva motor cycle with wickerwork side car owned by J. A. Whitmarsh. Both these vehicles were driven to the exhibition by their owners.

The ever popular harmonograph fascinated young and old, and many tried their hands at producing designs until the large stack of paper which had been provided was exhausted. Nearby, junior members were building model aircraft, and there were two " OO " gauge railway



A rear view of " the thing "

layouts operated by Mr. Oxlade and the sons of Mr. S. T. Brown respectively.

The number of models exhibited was fewer this year, but the quality was high. Dominating the locomotive stand was Mr. James Perrier's massive S.A.R. 4-8-2 freight locomotive to 1-in. scale which has undergone steam trials since the recent article in THE MODEL ENGINEER. The Cheltenham Society sent some outstanding exhibits, including a fine 5-in. gauge "Butch" by Mr. N. H. Toomey, who also exhibited an "1831" petrol engine and an "M.E." road roller power unit and dynamo, both used as stationary engines; Mr. C. T. J. Nichols's prizewinning vertical tandem compound steam engine and "M.E." road roller, and Mr. J. S. Burgess's twin o.h.v. ¾ in. bore and stroke steam engine adapted for twin screw drive. The latter model ran on air during the exhibition as also did Mr. O. T. Wicks's (Andover) well-known showman's engine and some other engines, including a 1 in. bore 2 in. stroke Brearley and Stevenson horizontal engine built in 1911. The society possesses the original Brearley & Stevenson catalogue which gives the price of the castings (all gunmetal) for this engine as 12s. 6d. with an extra 9d. for fully machined cylinder and covers! Another Andover entry was a highly finished example of a "Unicorn" engine lent by Mr. W. Jennings, his second attempt at model engineering.

Another Westbury design exhibit was Mr. H. Scamell's hydroplane *Ark* powered with a Kittiwake engine. Mr. Scamell, who made a very welcome return to exhibiting, also lent a showcase of small items including a rotary milling table, pressure gauge, injector, vertical slide and set of carriers for a 2½ in. precision lathe, all made to his extremely high standard.

A large contingent of models came from the Southampton Society, among them being Mr. E. F. Speller's own-designed launch featuring a planked deck, Mr. R. W. A. Cross's tug *Gondia* coal-fired, which though uncompleted, showed great promise.

The Trowbridge Society also gave splendid support, an extremely fine exhibit being a fast runabout launch to 1-in. scale with double diagonal planking in 1/24-in. mahogany veneer by Mr. K. W. Shonk. Another neat model was the *Invicta* chassis shown by 15-year-old C. E. M. Bradshaw.

Mr. J. Capper, of Salisbury, exhibited a decorative 16th century Elizabethan galleon and H.M.Y. *Katherine*, one of the 16 Royal Yachts of Charles II, built to a scale of 5 ft. to the inch. R. Read showed a half second electric battery clock made to C. R. Jones's design in THE MODEL ENGINEER and the Rev. G. S. Long who is over 70 lent a beautifully made G.W. "King" class 3½ in. gauge chassis. An unusual exhibit was a 12-pounder naval gun and mounting as installed in all British and Japanese warships built at Elswick during the last decade of the 1800's. This model was built by Mr. H. F. Pern during his apprenticeship at the Elswick works of Sir W. G. Armstrong Whitworth & Co. from 1898 to 1903.

A neat 5 c.c. single-cylinder water-cooled 4-stroke petrol engine coupled to a generator, both of his own design, was exhibited by G. D. Lovell.

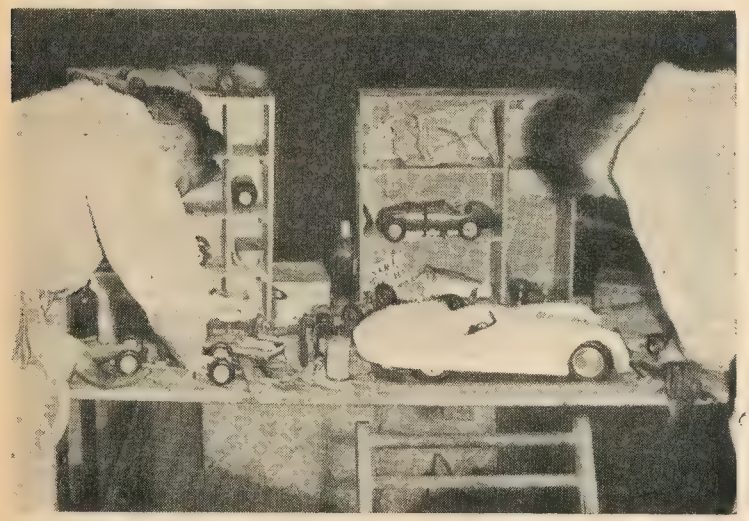
Among the many aircraft models the most outstanding was a twin-engined canard type of original design, which can fly on either or both engines, built by R. A. Guntrip, and an extremely well finished and detailed 1/24-in. scale model of a *Spitfire* standing "ready for scramble." Taking pride of place among the aircraft was the "Gold" trophy won by a Salisbury member, A. M. Piacentini, for control-line stunt flying at last year's British National Championships.

The society are deeply grateful to Mr. A. T. Tamplin for bringing over his Churchill tank with all its associated equipment and to the keen co-operation also given by Messrs. Howell and Barnett, who drove their Foden tractor *The Mighty Atom* over from Andover. This fine old engine was in steam inside the hall on the first day and later was parked outside and made a trip or two round the town "showing the flag" to the astonishment of the citizens and traffic. Many people took advantage of the invitation to climb up into the cab.

Other stands were taken by the R.A.F. who showed aircraft models and apprentices' test pieces; the Salisbury College of Further Education, with students' work, and Machine Tools (Letchworth) Ltd. of Salisbury, makers of flexible pressure pipes and fittings who had an interesting stand. Two tables devoted to free leaflets and back numbers of THE MODEL ENGINEER and other publications were quickly cleared despite strict rationing.

A pleasurable feature of model engineering exhibitions is the renewal of old acquaintances and the making of new friends, and this one was no exception. Model engineers from Bristol, Southampton, Trowbridge, Cheltenham, Basingstoke and Andover, among other places, made themselves known and some were taken for a look round the society's new headquarters. A very welcome visitor was Mr. E. T. Westbury, paying his first visit to a Salisbury M.E. Exhibition.

Many enrolment forms were taken and the society are already having an influx of new members, including several small gauge railway enthusiasts, and it is hoped that this may lead to the formation of a new section for this branch. Paying attendance at the exhibition was over 4,000. This was somewhat lower than at the last show, probably due to the prevailing weather.



A few of the model cars "at the pits"

QUERIES AND REPLIES

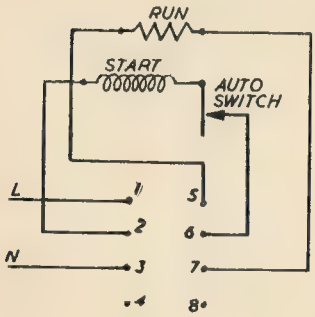
"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Reversing Switch Connections

The electricity supply to my workshop was recently changed from d.c. to a.c. I have obtained a ½ h.p. capacitor start motor, and wish to connect it to a Dewhurst reversing switch. Will you please give me a diagram of the connections for this type of motor so as to use the Dewhurst switch for reversing?

L.P. (Faversham).



The connections for your motor will be as shown in the diagram, using a "Dewhurst" switch. Reversal of this style of motor is accomplished by reversing either the starting or running winding, but not both. It is usual to use the starting winding for reversal.

Fabricating Lathe Bed

I am proposing to build a 3½-in. lathe, and intend to fabricate the bed from ¼-in. thick black iron for all the lower part, including the cross members, with ½-in. × 4-in. bright mild-steel, welded on top for the shears. I would appreciate your opinion as to whether this would be satisfactory, and also any further advice on the matter. I can get everything electrically welded at a moderate price, and can do the surface grinding myself.

A.I. (Bradford).

We have no personal experience with this method of fabrication, though we understand that it is now being used to some extent in the construction of large machine tools. In such cases, however, it is usual to normalise the entire structure after fabrication, and also to flame-harden the sliding surfaces.

One of the disadvantages of mild-steel as compared to cast-iron for machine tools, is that it is not so well adapted to take sliding wear, and scoring by trapped particles of metal in the slides is more likely to take place.

In the circumstances, we cannot state definitely whether this venture is likely to be successful.

Driving a 3½-in. Lathe

I have obtained a 3½-in. back geared screw-cutting lathe, and would appreciate your advice as to the most suitable type of motor. I propose to obtain a 1/3 h.p. motor, with stop and reverse switch. The pulley on the lathe countershaft is 5-in. diameter, and I have a 1¾ in. diameter pulley for the motor. What speed of motor shall I require, and what steps will have to be taken to screen the motor against T.V. interference?

K.A.P. (Blaby).

The size of motor you specify will be amply powerful for your purpose. The sizes of pulleys suggested, however, are rather on the small side, and we should suggest using a pulley of not less than 2-in. diameter for the motor, driving a pulley of 7 in. to 8 in. diameter on the countershaft.

The actual countershaft speed will depend very largely on the class of work which is principally carried out on the lathe, and for lathes of this size, the main countershaft speed is usually between 300 and 500 r.p.m. The standard types of fractional h.p. motors are usually of the 4-pole type running at a speed of 1,425 r.p.m. to 1,450 r.p.m.

You do not state whether your current supply is a.c. or d.c., or the supply voltage, but assuming that you are on 220 volt a.c. supply, a standard split-phase type of motor will suit your purpose. This type of motor does not cause interference with T.V.

Drive for Drilling Machine

I have obtained a ¼ in. capacity sensitive drilling machine, which I propose to drive by means of a Brook single-phase ⅛ h.p. motor. I do not expect to require this for drills larger than 3/16 in. diameter.

(1) *What are the most useful spindle speeds for drills within the range of sizes mentioned?*

(2) *Does this type of motor cause T.V. interference?*

(3) *What steps can be taken to suppress it effectively?*

G.H. (Cleckheaton).

(1) We suggest that spindle speeds between 1,500 and 6,000 r.p.m. would be most suitable for your purpose. The precise range will, of course, depend on the relative diameters of the driving pulleys.

(2) The type of motor specified does not cause interference with radio or television, except the slight and momentary interference at the opening and closing of either the main switch or the internal contacts of the motor.

(3) No suppressor will be found necessary in practice.

Rewinding Transformer

I have a transformer with an input of 250 volts and output of 13.5 to 15 volts at 60 amps. Will you please tell me if this can be modified to give a smaller voltage, output say, 3 to 6 volts with twice the amperage without completely dismantling the transformer?

F.B. (Bishop-Auckland).

The ability to make this alteration without completely dismantling the transformer will depend upon the details of its design.

If the secondary windings of the transformers are on a separate limb or otherwise arranged so that they can be removed without affecting the primary winding, it should not be difficult to do this. The secondary winding will be the winding having the thicker gauge of wire, and the number of turns in the secondary will be directly proportional to the output voltage, that is to say, assuming that the 15-volt winding has 150 turns, the winding necessary to produce 6 volts will have 60 turns.

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

THE RESULTS

DEAR SIR,—Thank you for publishing my letter "There is Always Something" (THE MODEL ENGINEER May 6th.) The results have been that I have been given workshop facilities by Mr. Dennis Hayward of Bideford, and during the past few weeks have been able to complete my 3½-in. gauge locomotive *Bantam Cock*, using this gentleman's tools and materials.

I am happy to say that the performance on the track has fulfilled expectations. During the first steam trials, which extended to 3 a.m., I was assisted by Mr. Hayward; this shows that the enthusiasm which exists between model engineers is not confined to advice alone. I am also indebted to Mr. Locke of South Molton for the loan of all the notes relating to the construction of my engine.

Yours faithfully,
Bideford. J. DAVIES.

EXPERIMENT ON A LATHE

DEAR SIR,—I have lately carried out an experiment on my Corbett "XL" 4¼ in. centre lathe. I found, after a short time, that although every precaution had been taken to keep the bed free from chips, cast-iron dust, etc., that the ornamental scraping marks on the bed were wearing away; so I decided to fit a simple spring-loaded adjustable fitting to the apron of the carriage, working on the edge of the chip-tray, to carry the weight of the front part of the carriage which I found was 18 lb. After 12 months in almost daily use, not only has it saved the bed from any further appreciable wear, but it has also relieved the wear on leadscrew and nut.

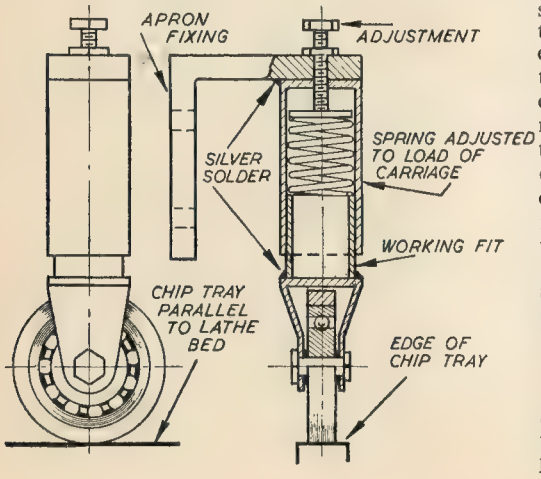
I have no fault to find with my lathe otherwise, and I am pleased to say it will turn out a good job; but I am of an opinion that on most modern small lathes the beds are soft grey cast-iron.

Yours faithfully,
Aldershot. H. F. KEMP.

"L" PLATES AT THE BENCH

DEAR SIR,—The amusing incidents related by "Cadet" in the issue for April 8th last, bring back memories of similar trials and tribulations which I experienced some years before the war and I am tempted to offer to those of us, who would also seek to own a serviceable collection of tools and equipment, some words of encouragement.

Like many other fellow enthusiasts, I have gradually possessed myself of a workshop, containing a motorised lathe, bench drill grinder and usual assortment of hand tools, etc., over a considerable period of years, and it has often been a long and difficult struggle to afford various items of equipment, but in spite of many difficulties and setbacks, and of course the war, the workshop has flourished. Various models have been completed, including two locomotives, a traction engine, a full-size four shaft pedal loom in steel for my wife, electric clock, etc. to say nothing of numerous other obligations; spares for the car, pins, bushes, etc., odd fittings, repairs without number also extensions to the domestic plumbing and electrical installations, the list seems endless. Finally, I must have spent thousands of hours of pleasurable endeavour, which is truly worth while.



Twenty years ago I managed to obtain a very battered and worn 3⅛ in. lathe of popular make, and after much effort, careful investigation into past copies of THE MODEL ENGINEER it was finally persuaded to function. Although its accuracy was always a matter of question, much useful work was done on the machine and a very great deal was learnt on how to avoid chatter, how to grind tools with Stone Age equipment, the theory and/or practice of slides, their fitting and adjustment. My vocabulary increased in direct proportion. Many makeshift lash-ups appeared from time to time to assist in completing various operations, when new accessories were quite out of the question. Some of these "Harry Tate" concoctions were eminently successful. However, the great satisfaction obtained from completing what previously appeared to be an impossible task was ample compensation.

Some time after the last war, I felt I had justly earned a somewhat better lathe and other equipment. In 1949, after the style of "Cadet," I set forth in quest of advertised machines. The prospect was hardly encouraging, rearmament was under way again, delivery uncertain, prices astronomical. I also received the same advice as "Cadet" from "those who should know."

I finally decided on a modernised version of my old friend, a total of nearly £30, less chucks and motor. This little machine has proved a revelation being of excellent finish, accurate and thoroughly dependable. To those of us whose limit in size, as far as locomotives are concerned, is a 2½ in. or 3½ in. gauge machine, this type of lathe will do all that is necessary. If of course you can afford to spend more money, you will obtain undoubtedly proportionately greater value. However, I am very satisfied. Happily for model engineers there are several similar machines advertised by highly reputable manufacturers and there is no doubt that they will each be just as satisfactory, so you can take your choice.

So to those of us who like myself, have to acquire their equipment the hard way, do not be discouraged if you find the cost of new equipment prohibitive.

I built my present lathe stand including countershaft support and cupboard for less than 10s. using angle steel (bed irons); it is solid,

vibration free and permanent. In any case, the more equipment you make or rebuild the greater will be your store of useful knowledge.

Yours faithfully,
Dinas Powis. "AUSTERITY."

TANGYE ENGINES

DEAR SIR,—The article on Tangye engines in THE MODEL ENGINEER of 27/5/54 prompted me to take a look at an old horizontal engine at a bottling store I visited. A plate bears the legend "Tangye's 'Colonial' Engine, 4½ in. × 7 in." The store foreman thought the engine was about 52 years old; he had worked the engine for many years until it was replaced by an electric motor at the end of the war. The engine is still in working order, apart from a missing lubricator and accumulated dust. The owners had tried to get rid of it, but could not find anyone to take it, even as scrap. I am sure they would be pleased to give it to any enthusiast or society if the receiver would undertake to remove it. Anyone interested could contact me through THE MODEL ENGINEER.

The engine lies at Bishops Stortford, Herts. There is a boiler to go with it, but its removal would not be easy, and the owners may or may not want to get rid of it.

Yours faithfully,
Watford. D. W. B. CARNAGHAN

Next Week . . .

MODEL POWER BOATS
Two important M.P.B.A. events, the National Speed and Radio Control Regattas, are illustrated and reported by "Meridian."

MAKING SMALL STUDS
K. N. Harris gives some practical information on a problem which every constructor of mechanical models will often encounter.

A FIVE-CYLINDER RADIAL ENGINE
One of the most advanced miniature petrol engines to be commercially produced, the Burgess M5, is described by G. P. F. Chinn.

MORE ABOUT THE "BUMBLE BEE"
This instalment will deal with the details of the exhaust system and ignition equipment, including h.t magnetos and alternative l.t. generator systems.

FACTS
L.B.S.C. devotes a "Lobby Chat" to pointing out a few pertinent and important facts regarding the running of small steam locomotives.

FOR TRACTION ENGINE FANS
W. J. Hughes "Talks about Steam ..." this time a fine Fowler engine, No. 14862, named "Excelsior," and provides some very useful close-up views of details.

WITH THE CLUBS

Bedford M.E.S.

Once again we are in trouble with the weed problem at Longholme Lake, Bedford, and we have arranged with the Wicksteed M.Y. & P.B. Club to hold our regatta at Wicksteed Park, Kettering this year. The date remains the same, Sunday, August 8th.

Regatta Secretary: W. H. MALONEY, 112, Highbury Grove, Clapham, Beds.

The Railway Enthusiasts' Club

This club will open its new clubroom, exhibition room and library on July 27th. It is situated near Farnborough (main line station) and all railway enthusiasts (members and non-members) are welcome—most evenings and every week-end.

A few vacancies still exist for a week's tour of North Wales, from August 14th to 21st. The places to be visited include the Penrhyn Quarry Railway; the narrow-gauge Welshpool and Llanfair Light Railway; the Shropshire and Montgomeryshire Light Railway; and numerous other lines of interest. Anyone interested is invited to contact the secretary, as soon as possible.

The club caters for those interested in all aspects of railways; and in steam road locomotives and stationary steam engines—prototype only.

Copies of the club programme, and details of membership, are available from the Hon. Secretary: H. DAVIES, "Lynmouth," Sycamore Road, Farnborough, Hants.

The Stephenson Memorial Miniature Locomotive Association

An annual general meeting of the above association was held at the Vane Tempest Hall, Durham, on June 26th, when delegates from societies in the North East Coast attended.

The chairman appointed for this year's office was Dr. W. H. Maclennan, the present chairman of the Tees-Side Society of Model Engineers.

It is hoped to hold a rally on the Sunderland track, Roker Park, in the very near future, when other societies will be invited to take part.

Hon. Secretary: J. W. CARTER, 28, East Avenue, Billingham, Co. Durham.

Eltham & District Locomotive Society

The next meeting will take place at the Beehive Hotel, Eltham, at 8.0 p.m., Thursday, August 5th. It has been arranged for Mr. A. C. Clarke of the Welling Society to come and talk to us about an articulated locomotive that he has built. As Mr. Clarke intends to bring the locomotive along with him, it should be an evening of great interest to all members.

At our last meeting Mr. Powell was unable to give his talk, so the evening wound up with a "Lobby Chat."

Hon. Secretary: F. H. BRADFORD, 19, South Park Crescent, S.E.6.

Bethnal Green S.M.E.E.

The club has recently enjoyed several visits to places of interest, among them Odhams Press, Tower Bridge where the hydraulic machinery was much appreciated, and to Gravesend where a number of tugs were clambered around and much enjoyed.

Our workshop at the Bethnal Green Men's Institute is now officially closed for the summer period until September, when we shall be open to members and visitors every Tuesday evening, at 7.30 p.m. In the meantime, we have arranged another visit to Tower Bridge on August 21st, and on September 17th we have a visit to the *Daily Mirror* printing press.

A visit is being arranged to Swindon Locomotive Works, for October 3rd, and on the resumption of our full workshop meetings in September, we have a programme of film shows for October 22nd, November 19th, and December 17th. These film shows are open to all interested, as is also our workshop, and shows take place on Friday evenings, 7.30 p.m., on dates mentioned, at the Bethnal Green Men's Institute, 229, Bethnal Green Road, London, E.2.

All correspondence to: Hon. Secretary: A. W. MYERS, 208, Crownfield Road, London, E.15.

THE MODEL ENGINEER DIARY

July 25th.—Victoria Model Steamboat Club.—Regatta at Victoria Park, London, E.9.

August 11th, 12th, 13th, 14th.—Exmouth & District Society of Model and Experimental Engineers.—Exhibition at the Y.M.C.A. Hall, Victoria Road, Exmouth. Opening day from 7.30 p.m. to 9.0 p.m.; other days from 10.0 a.m. to 9.0 p.m.

August 16th, 17th, 18th, 19th, 20th, 21st.—Ramsgate & District Model Club.—Exhibition at Club Headquarters, Princes Street, off Queen Street, Ramsgate. Open from 3.0 p.m. to 9.0 p.m. daily, except on Saturday, when the opening time will be 10.30 a.m.

August 18th, 19th, 20th, 21st.—Weymouth & District Model Engineering Society.—Model Railways and Engineering Exhibition, at the Melcombe Regis Boys School, Weymouth. Open from 11 a.m. to 9 p.m.

August 18th, 19th, 20th, 21st, 23rd' 24th, 25th, 26th, 27th and 28th.—The Model Engineer Exhibition, in the New Horticultural Hall, Greycoat Street, Westminster, S.W.1. Open from 11 a.m. to 9 p.m.

August 23rd to September 4th.—Exeter and District Model Engineers' Society.—Exhibition at the Friernhay Hall, Exeter.

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WORKSHOP EQUIPMENT

Buck & Ryan for Lathes and Accessories, drilling machines, grinders, electric tools, surface plates, etc.—310-312, Euston Road, London, N.W.1. Phone : Euston 4661.

Rebuilt Lathes. The Acorn Machine Tool Co. (1936) Ltd., offer rebuild to limits "Acorntools" and "Atlas" 10" swing s.s. available. Write—610-614, Chiswick High Road, W.4. (Phone : CHI 3416).

Orders can again be accepted for ⅜" bench drills, 20 d.p. gears, castings for our 4" lathe, and all our standard lathe components. S.A.E. 3d. stamps for list.—Perfecto Engineering Company (Machine Tools), 60, Stanley Street, Leicester. Phone : 20078.

New (Slightly Soiled) 2½" 3-jaw (reversible) scroll chucks (model 32) Burnerd, reduced from £5 8s. to £3 10s. (1s. 9d. p. and p.). List supplied on request.—John Morris (Clerkenwell) Ltd., 74, Clerkenwell Road, E.C.1.

"Acorntools" and "Acorntools" De Luxe 5" s.s. and s.c. lathes, also "Acorntools" 7" stroke high-speed shapers and ½" capacity capstan lathes can be supplied *ex*-stock. Hire purchase terms available. Send for literature and full details to the manufacturers of these machines.—The Acorn Machine Tool Co. (1936) Ltd., 610-614, Chiswick High Road, Chiswick, W.4. Tel. : 3416-7-8-9.

Immediate Delivery from Stock. Myford "M.L.7" and "Super 7" lathes, Grayson, Super Adept lathes, bench planer, shapers, electric motors, small tools.—F. W. Kubach, 12, Sylvan Road, London, S.E.19. Lib. 3311/12.

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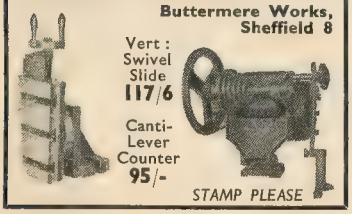

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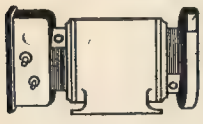

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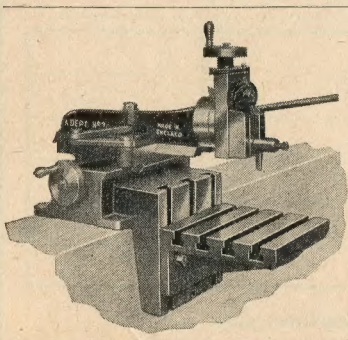

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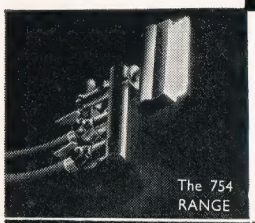

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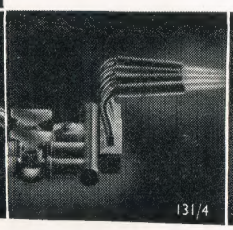

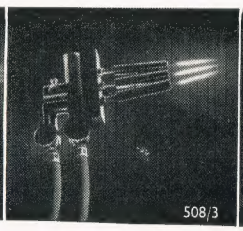

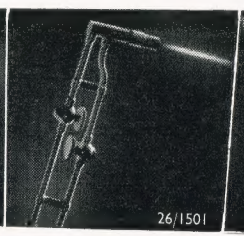

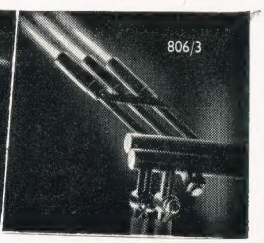

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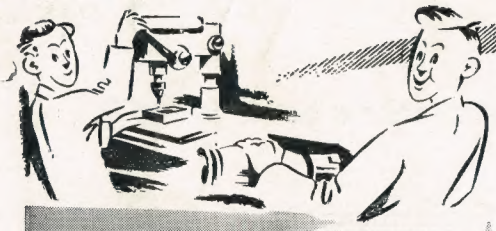

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